Aalto University
School of Engineering

Hannes Kallioinen

Strengthening the Practices of Experiment-Driven Innovation

Diplomityö, joka on jätetty opinnäytteenä tarkastettavaksi
diplomi-insinöörin tutkintoa varten.

Espoossa 09.01.2017
Valvoja: Professori Kalevi Ekman
Ohjaaja: Markku Häivälä

Aalto-yliopisto
Insinööritieteiden korkeakoulu

Aalto-yliopisto, PL 11000, 00076 AALTO
www.aalto.fi

Diplomityön tiivistelmä

Tekijä Hannes Kallioinen		
Työn nimi Kokeilulähtöisen innovaatiokulttuurin käytäntöjen vahvistaminen		
Koulutusohjelma Konetekniikan koulutusohjelma		
Pääaine Koneensuunnittelu		**Koodi** K3001
Työn valvoja Professori Kalevi Ekman		
Työn ohjaaja DI Markku Häivälä		
Päivämäärä 09.01.2017	**Sivumäärä** 77+33	**Kieli** englanti

Tiivistelmä

Innovaatioiden jatkuva tuottaminen on välttämättömyys mille tahansa liiketoiminnalle, joka haluaa ylläpitää tai parantaa markkinatilannettaan. Alkupään innovaatioprosessin tehokkuus on keskeisessä roolissa koko tuotekehitysprosessin toiminnan kannalta. Ideoiden altistaminen kokeiluille nähdään tehokkaana tapana parantaa uusien tuotteiden ja palveluiden kehittämisessä (eng. New Product Development, NPD).

Tutkimuksen tarkoitus oli ymmärtää kokeilukulttuurin heikkoudet ja vahvuudet NPD:n kontekstissa, ja tämän jälkeen muodostaa käytännön suosituksia kohdeyritykselle, KONE Oyj:lle. Työn tutkimusosuus koostui kyselystä sekä kolmesta paikallisesta kenttäkokeesta, joiden avulla pyrittiin ymmärtämään KONE Oyj:n nykyisen innovaatioprosessin heikkoudet ja vahvuudet. Tavoitteena tutkimuksessa oli arvioida kokeilukulttuurin helppoutta ja näiden havaintojen pohjalta luoda suosituksia, jotka tukisivat vahvempaa kokeilukulttuuria.

Tutkimustyö tuotti kolme havaintoa: Ensinnäkin havaittiin, että nykyiset prosessit eivät kannusta tai vaadi idean omistajaa tekemään kokeiluja. Ohjauksen havaittiin olevan liian kevyttä ja näin ollen moni idea lopulta kuihtui. Toiseksi, tutkimuksessa havaittiin, että mikään yksittäinen tekijä ei vaikuttaisi estävän kokeilujen tekemistä. Havainnon mukaan kuka tahansa kykenee tekemään kokeiluja halutessaan. Kolmanneksi, sekä kysely että kenttäkokeilut osoittivat, että saatavilla olevista resursseista on tarjolla tietoa ja ymmärrystä hyvin niukasti, jotta ideoita voisi kehittää käytännössä eteenpäin.

Tehtyjen havaintojen pohjalta työ suosittelee joukkoa käytännön suosituksista, joista osa voidaan toteuttaa välittömästi ja osa pidemmällä aikajänteellä. Tämä diplomityö tehtiin läheisessä yhteistyössä KONEen innovaatiojohdon kanssa Hyvinkään toimipisteessä.

Avainsanat innovaatio, kokeilu, kokeilukulttuuri, prototypointi, oppiminen, tuotekehitys

Aalto University
School of Engineering

Aalto University, P.O. BOX 11000, 00076 AALTO
www.aalto.fi

Abstract of master's thesis

Author Hannes Kallioinen	
Title of thesis Strengthening the Practices of Experiment-Driven Innovation	
Degree programme Mechanical Engineering	
Major Machine Design	**Code** K3001
Thesis supervisor Professor Kalevi Ekman	
Thesis advisor Markku Häivälä M. Sc. (Tech.)	
Date 09.01.2017 **Number of pages** 77+33	**Language** English

Abstract

Producing continuously any type of innovations is necessary for businesses to maintain or improve their market position. The effectiveness of the early stage of the innovation process is playing an essential role in the whole process of new product development (NPD). Exposing an idea to experimentation is considered as an effective way to improve the development of new products and services.

The purpose of the research was to understand the strengths and best practices of experimentation in NPD through a literature review and then formalise practical recommendations for the case company, KONE Corporation. The case study, a combination of a survey and field experiments, focused on understanding the strengths and weaknesses of the current arrangements of KONE innovation process. The goal was to assess the ease of experimentation and based on those findings to suggest practical recommendations to create a change towards an innovation culture that involves more experimentation than currently.

The research produced findings as follows: First, the current practices were not encouraging or demanding an individual ideator to implement experiments. The governance was found to be too open, and therefore many ideas had faded. Second, nothing was found to hinder experimentation during the implementation of the field experiments. The finding suggests that proactive attitude can enable the implementation of experiments. Third, both the survey and field experiments demonstrated that the information and awareness about the available resources for innovation development have room for improvement.

Based on these findings, the research suggests a list of practical recommendations for immediate and near future implementation. This thesis was done in a close collaboration with KONE Innovation Management, in Hyvinkää, Finland.

Keywords innovation, experimentation, prototyping, front-end, learning, product development

Acknowledgements

Here I am, sitting in a class room and writing the very last sentences of my long-lasting student career. It feels wistful, surreal and elated. On autumn 2008 when I started at TKK as a freshman I had no idea what the next eight years would bring on. One morning on that autumn I found myself entering a building that university had just opened. The building was called *Design Factory* and a Professor called Kalevi Ekman had invited us, a small group of new students, to have a breakfast with him. Apparently that visit became a turning-point for my studies since I started spending time more and more at Design Factory, taking interdisciplinary courses and meeting inspiring people. I got DF'd.

Product development in a great team and uplifting environment is simply fantastic. There are no right or wrong answers, but some theories and practices apply more than others. However, at some point of my studies I was slightly concerned that I have really not learned anything special or useful like the typical engineers do. Then came the thesis. In terms of credits this thesis represents only 10% of the whole degree, but in terms of learning experience and deep understanding about a specific topic this thesis project has been both a crown and a touchstone for my studies. The past year has taught me to read and analyse data from various sources, as well as formalise own academic output in English – something that felt almost impossible a few years ago. Moreover, I have learned what experimentation is and how any business should have an approach that utilises the power of experiments. Now I feel that I have gained a real skill which I can apply regardless about the field of business or my own project during leisure. I also feel that the sponsoring company, KONE, has learned a lot and has now a toolbox for strengthening the culture of experimentation in their daily operations.

Speaking of the topic itself, experimentation is something that mankind has always needed in order to find something new and interesting. Curiosity and eagerness is something that we should always have in our mind when we get ideas or face challengers in our life. Sometimes an experiment fails, sometimes not. What happens always is learning. Viva la experiments!

Naturally, the studies would have offered just a dull degree without the amazing people from our Aalto community. I cannot express my appreciation for all the dear friends and colleagues from Koneinsinöörikilta, Autokoulu, Design Factory, Startup Sauna and all around the student union. You have given me something that you cannot buy or study. Thank you. Likewise I want to thank all the people who have involved into this thesis project, starting from Mikko Mattila who initiated the project and made me understand what the dream topic for the thesis could be. The thesis advisors Markku Häivälä, Kirsi Nyrhinen, Ari Hänninen, Hannu Nousu and other KONE people made a great job and taught me a lot, thanks! An acknowledgement belongs also to my family and relatives who have always remembered to support me and ask when I will graduate. It's now. Lastly, I owe a huge bow for my inspiring professor Kalevi Ekman and rest of the great staff at Aalto University. It feels privileged to graduate from a place like this.

Hugs,

Hannes Kallioinen
Aalto Design Factory, Espoo 09.01.2017

Table of Contents

Abbreviations

EDI	Experiment-Driven Innovation
FEI	Front-End of Innovation
FFE	Fuzzy Front End
NPD	New Product Development
R&D	Research and Development

KONE-specific abbreviations

BB	Blue Boxing
CR	Change Request
DS	Develop Solutions
SCP	Solution Creation Process

1

Introduction

We need to run pretty damn fast, so that we even stay still.

-Pekka Herlin

1 Introduction

Ideas are the beginnings of the new opportunities. Eventually the most promising ideas can grow into innovations, which are an essential part of sustainable business. Virtually all companies have been seeking ways to generate business growth, or at least maintain their market position, by releasing new products and services. The key element in this pursuit of growth is continuous innovation, and especially Research and Development (R&D) units are designed to continuously produce innovations. Often the company-specific processes and practices define the ways in which ideas should be generally treated, but even the most brilliant ideas can fade if these innovation processes are not well adjusted and followed, or the prevalent atmosphere is not ripe for the development of innovations. Fortunately, the ability of a company to commercialise ideas into innovations can be endlessly developed. Depending on the company and its special features, some of the parts in the innovation process may be already well covered. Even a single weak link can cause insurmountable problems in the whole process. However, innovation is not the only important element in a successful and sustainable business–sufficient time and money are required for the R&D work ensuring that uncertain ideas can be brought to solutions that can be sold.

New Product Development (NPD) starts from the Front-End of Innovations (FEI) where raw ideas are generated. Most of the ideas raise many open questions that should be solved in order to know if the idea should be adopted into the more formal development processes. Experiments are considered as an effective way to gauge the applicability of an idea. Experiments do not only test the idea, but also yield new insights into the ways the idea could be improved. The earlier the experiments are implemented, the more the employees can learn from the experimentation. However, there are some challenges that in which no experiments are conducted, thus rendering uncertain the applicability of the idea. Firstly, the experiments require proactive effort from the ideator–not all the experiments can be executed just by sitting in an office. Secondly, an experiment itself does not hold intrinsic value. An experiment needs to be well designed ensuring that the results offer the answers required for these uncertainty factors. Thirdly, the challenge in experimentation, and more generally in innovation development, is that large business organisations are typically not designed for innovation; they are designed for ongoing operations. Nonetheless, even the most conservative managers know that the strategy of the company cannot be about maintaining status quo. The crux of the matter is to find the best balance, thus creating a harmonic symbiosis in which the existing operations and innovation activities deliver novel products to the market.

This thesis is a practical research of the ways in which a global corporation could strengthen the practices of experiment-driven innovation in their R&D work. The focus is on the early part of the innovation process–on the area that has the most flexibility and room for improvement with far-reaching effects. This research work is organised as follows. First, the context, research questions and general approach are introduced. Second, experiments are believed to play an essential role in the early innovation process, and this impact is familiarised. This chapter already covers some key findings from the professionals. Next, the findings from literature and from the best-performing companies are described, and after that, the company behind the case study is introduced, which is followed by the hypotheses and case study itself. Finally, the results, findings and practical recommendations are discussed. The study is done in close collaboration with the case company, but eventually the findings, opinions and suggestions are the output of the author.

1.1 Background

KONE Corporation is well known for its innovative solutions - for the fifth year running, KONE has been included in the Forbes list of the 100 most innovative companies in the world. KONE ranks 48th in the 2015 list. (KONE Corporation 2015b) Naturally KONE wants to maintain and develop its position as the most innovative company in the market and therefore KONE established a new Technology & Innovation Unit in autumn 2015:

KONE will establish a new Technology & Innovation unit headed by a Chief Technology Officer (CTO). Tomio Pihkala (40) has been appointed CTO of KONE to head this unit. He has worked in various roles within KONE since 2001, and has been a member of the Executive Board since 2013, responsible for Operations Development.
The new Technology & Innovation unit brings together KONE's Research & Development and IT functions.
"By establishing a dedicated Technology & Innovation unit we will speed up our development in a changing business environment. The opportunities from digitalization are accelerating in our industry. We see a lot of new and exciting ways to improve customer and user experience as well as the quality and productivity of our operations. Tomio's strong technology background and his future-oriented approach make him an ideal person for this new role," says Henrik Ehrnrooth, President and CEO, KONE Corporation. (KONE Corporation 2015a)

KONE innovation process, called Solution Creation Process (SCP), ensures that the best ideas reach the market as solutions that are valuable and completed. Currently, the Time to Market (TTM) has room for improvement at KONE, and one of the most effective ways to cut TTM is to improve the performance at the front-end of innovation. Therefore, redefining the existing innovation processes at KONE is part of the renewal actions that covers everything from FEI to product launch. To be simple, the key challenge is that how all the global R&D units – and also the external partners – could collaborate in an efficient, but innovative way. Ideas may come from any unit at any time, but the question is about who is able and supported to push the idea forward. Recently KONE Innovation Management has noticed that the vast amount of ideas could be capitalised more efficiently. The base assumption is that most of the idea creators are not making enough, if at all, experiments or prototypes about their ideas. Therefore, one of the areas that Innovation Management has recently decided to focus on, is the leap from FEI to Blue Boxing (BB), where the front-end's rough concepting is shifted to BB's uncertainty management. Especially when evaluating an idea in the end of FEI, the data and learnings from experiments would help the decision making before moving to BB where further experiments are needed as well.

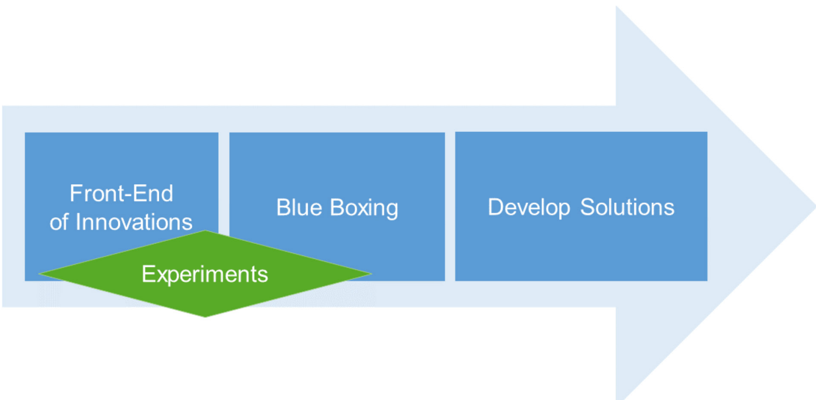


Figure 1 The area where experiments are needed in the whole innovation process

Part of the desired results in the development of FEI phase is to get more people involved into innovation activities in general. The basic philosophy at KONE is that innovation belongs to everyone in the company, but currently only the most creative and loudest employees are collaborating in building innovations. However, Innovation Management hopes and believes that there are more innovative people in the company, but these people just need a different invitation to join the innovation activities. We are all innovators, but somebody just needs to find the right methods to kindle the creativity in people's minds (Wheatley 2002).

KONE did a comprehensive innovation barometer in 2012 and 2013. The research, made by Gearshift Group, pointed out that there are big differences, like the freedom to ideate, between KONE's global R&D units. A salient part of the barometer's results is the so called *Strain of Innovation* – a comparison whether the unit focuses on creating and implementing new ideas or is the unit's main focus on managing existing operations, the Product Change Management (PCM). According to the study by Gearshift Group (2013) the balance between innovation and ongoing operations at KONE is not permanent, and the study points out that actually top management can easily change the alignment by defining new focus areas for R&D. However, the downside of a sudden change between balance of PCM and innovation is that the long-term projects are compromised and people might feel frustrated. Therefore, the possible renewal actions considering the experimentation in FEI – and innovation more generally – must be deliberately introduced.

1.2 Terminology

Before diving deeper to the topic itself, it is good to through what each words stands for in the context terminology. Using the precise word is not crucial in the everyday discussions, but then again it is good to know what the fundamental differences between the terms are, so that at least the top-down communication is not misleading and mixing employees minds.

The most common word we hear and use daily is **prototype**. A prototype is an initial model of an object built to test a design, and it is often made in single units. A prototype can be anything between quick and dirty or explicit and polished. A prototype is made to illustrate or demonstrate a functionality or appearance, and therefore it is also a great communication tool for the development team. In the past, prototypes were typically just physical objects, but nowadays a prototype can be electronic as well, for example a mobile application. (Prototype. 2015) The verb *prototyping* refers to an activity where prototypes are produced in order to get more variance to the models and designs of a product. (Cambridge Dictionary 2016d) Very close to a prototype is a **mock-up** which is a physical or virtual object made in scale or full scale to illustrate the dimensions or layout. (Cambridge Dictionary 2016b) Mock-ups are typically used in projects that involve physical space, for example in architecture. A mock-up becomes a prototype if it is even partly functional.

Whereas prototype and mock-up remains as words that are in the context of a physical or electronic product or feature, a **test** is on a contrary a research method where the end result is believed to be known and it is just verified by testing. Tests are mainly trying to ensure that the most critical functions work and that the product is safe. Test is also a practical way to know what something can do or is like. (Cambridge Dictionary 2016e) Testing is typically done internally so that the possibly found defects do not become public and can be fixed before the product starts to enter the market, and therefore move towards the next optional step, called the **pilot**. Piloting is often described as a market validation phase where a product, that is virtually final, is put to a limited, but real environment to make data collection. The product that is about to enter the market is rarely withdrawn after a pilot – though some fine-tuning improvements can be made based on the learnings from a pilot. (Cambridge Dictionary 2016c)

However, passive observation or exploration is rarely enough, and offers very little of intervention to the fuzzy questions. By manipulating the environment in a specific way, it is much easier to learn about the possible phenomena and cause-effect relation. This research approach is called **experimentation**. It is a process of trials and errors where every iteration round generates new insights and knowledge on a problem. (Thomke 1998, Thomke 2003) In experimentation, everything starts generally speaking from curiosity and ignorance about something that we don't totally understand. The human mind is built to make experiments and learn – even the smallest children want to understand what happens when you throw a glass of milk to ground. An experiment is also a test, but the fundamental difference is, that we are seeking for limits by manipulating the test in order to learn something totally new. (Cambridge Dictionary 2016a) Experiments are the most effective method to cut uncertainty and learn. Often, a prototype or a mock-up is an important element of an extensive experiment. Experiments can be done either sequentially or parallel. (Thomke 2003, Thomke, Bell 2001) Section 2.4 is introducing the best practices in experimentation design.

In natural science, the experiments are considered either as natural experiments or quasi-natural experiments. The natural, or true, experiment is a research method where the population and methods are not manipulated. The difficulty in natural experiments is that the results can be difficult to interpret and besides that, the experiment itself can be difficult to repeat. Therefore, when a specific cause-effect relation is needed to examine or the random assignment is not possible, the experiment becomes quasi where population or methods are intentionally manipulated. Traditionally the quasi-experiments are used especially in economic, social and human behaviour research. (Meyer 1995, Millsap, Maydeu-Olivares 2009) In KONE's context, the human behaviour experiments become essential when for example a new user interface is being considered to launch.

Related to experimentation and its terminology, one of the findings from the literature review is that currently there is no clear categorisation available for experimental approaches. This finding about two the fundamental approaches, called *Goal-Oriented* and *What If? Oriented experimentation*, is presented in chapter 7.

Failing and **learning** are the neighbours of experimentation, and very often failing and learning go hand in hand. Experiments are supposed to generate either learning or cut uncertainty. Failure is an acceptable and natural part of experimentation. However, understanding the reasons behind a failure can be difficult, but easy to dismiss and ignore. Linking to this, Cannon and Edmondson (2005) argues that large organisations are not putting enough of attention to detect and learn about the small failures and warning signs which grow bigger and bigger on the background. A dominant success can drown partial failure easily, causing serious consequences: Atlantis Shuttle was successfully launched in 2002. A piece of foam broke free and damaged the rocket booster, and the failure was not concerned serious enough to postpone the future shuttle launches. Three months after this, the Columbia shuttle took off. A similar piece of foam hit the shuttles wing and caused the loss of the whole crew of seven. The first launch was concerned as a success, but the second launch was obviously a terrible failure, especially because the cause was known. (MADSEN, DESAI 2010)

The same research by Madsen and Desai (2010) argues that learning occurs more effectively from failures than from success. Another important finding, they address is that failure-based learning depreciates more slowly than learning from success. In the context of experimentation, the results are an essential role of the process. Simply speaking, an experiment without results sounds useless, and therefore the managers often emphasise to get good results from an experiment. However, Govindarajan and Trimble (2010) point out that organisations focuses too much on results on the expense of learning. This is totally understandable for results are everything what business is about. Still, the learning is more important than results, especially when making experiments.

The emerging trend from the 21st century has been to *fail fast* – the two words are often juxtaposed to successful NPD. Nonetheless, it should be remembered that failing is not necessary or intrinsic value in a process that aims to learn. Failure should be accepted, but not emphasised, and in matter of fact, KONE has revised the *fail fast* mantra is into *learn fast*. The case study in chapter 5 includes a survey where one of the questions concerned about learning as a part of KONE R&D work.

1.3 Context, Research Questions & Objectives

The case company, KONE Corporation, has limited understanding about the academic perspectives of experimentation. However, the background theory is considered as an essential part of the study before any practical recommendations are made. Therefore, the study focuses on understanding first the common perspectives of experimentation in the context of FEI and NPD. Then, these findings are applied on a practical level by proposing recommendations for the case company. An important part of these recommendations are the global aspects – a major part in the context of the study is to remember that the case company's R&D units are spread around the world. Therefore, the cultural differences need to be considered as well, once designing the final suggestions and recommendations.

The conjecture from KONE side is that the front-end of their innovation process should involve more experimental culture than currently. The objective for the research work is to find out whether the experiment-driven approach should be strengthened, and if yes, then address areas from improvement from the current arrangements. Based on this background and starting point, the research questions and objectives are designed together with supervising professor and KONE representatives. The goal is not just to observe and make comparative analysis from literature and other companies, but to offer practical recommendations that can be realistically implemented in all KONE R&D units around the world.

The key questions in the research:

- Why Experiment-Driven Innovation would make a step towards preferred?
- How to integrate Experiment-Driven Innovation into the existing innovation process?
- How to communicate a common guidance about the updated innovation process and its flow for all the R&D people?

The objectives of the thesis:

- Find and understand the strengths and weaknesses of current arrangements
- To make KONE R&D society more aware about the innovation process and its focus points
- Based on the findings, suggest recommendations for short term and long term implementation

Figure 2 The key questions and objectives of the research

1.4 Approach

KONE Innovation Management has empirically discovered that even the simplest experiments are yielding better results in the front-end of innovation where the initial idea often requires simple questioning and prototyping. Therefore, the base assumption from the case company's side is that stronger experimental culture would yield better results in the front-end of innovation. Nonetheless, the approach in the study itself is more neutral: The starting point for the research is to understand what experimentation really is, what pros and cons it possibly brings and, above all, how it could be possibly applied to KONE's innovation practices on a global scale, if considered as a useful method. The plan is to discover the best practices from literature and other companies, and then design and deliver a customised operation model for KONE, not forgetting to share the general findings about experimentation. That is to say that the study is not considering experimentation as an irreplaceable method in FEI, and moreover the study is taking into consideration all the other suggested methods how FEI could be improved.

Another key question in the approach is that what Experiment-Driven Innovation (EDI) really stands for? Is an experiment useful without any innovations? Is experimental culture the foundation of EDI? What causes experimental culture? Ultimately the key question in the approach is: Does experimentation matter in NPD?

1.5 Methods Used in the Research

The subject for this thesis was initially discovered and established in January 2016. The need was evident to make a research how the experimental culture could be strengthened at KONE on a global scale. Practical experiments with understandable results were seen as a fundamental part of the thesis. Therefore, the preparing of the case study experiments was seen as an essential part of the whole research work. Partly by coincidence, partly by purpose, a meta-experiment research method was invented. What could be better way to assess the ease and power of experimentation than just make real experiments based on real ideas – experimenting experimentation in a real environment. On a practical level these experiments would yield useful information about the possible bottle necks in the system. In total three different experiments were executed in KONE's facilities in Finland.

At the same time the research was supposed to understand how the situation is on a global scale. Making experiments in every R&D unit was not possible due to time and money constraints in the projects, and therefore the company-wide picture was gathered through a survey. This survey was targeted to the employees that had an approved idea in KONE's Innovation Tool. These 424 ideas, submitted by 254 different people were a perfect match with the research context, as these people should have made some experiments latest after the idea became approved in the system. However, it was immediately obvious that very few of these approved ideas had proceeded after the approval. By contacting the target group and asking the reasons behind this phenomenon through a survey, some new findings could be potentially made. The response rate of the survey became approximately 25% which is considered as acceptable level.

However, before making any practical experiments or sending any surveys, the research process started with a literature review. In total, more than 50 scientific articles and books were read, and especially the following books were found very useful in the beginning of the process:

- *Experimentation Matters – Unlocking the Potential of New Technologies for Innovation*, Thomke S.
- *The Other Side of Innovation – Solving the Execution Challenge*, Govindarajan V.
- *Kehitä Kokeillen – Organisaation Käsikirja*, Hassi L.
- *Managing Innovation, Design & Creativity*, Von Stamm B.

The facts, features and findings about experimentation in general are introduced in chapters 2 and 3, followed by chapter 4 that introduces the case company and how innovation is currently managed at KONE. After that, chapter 5 is the research entity itself which starts by introducing the hypotheses. Then comes the case study which is divided into two parts: survey and practical experiments about the ease of experimentation.

1.6 Delimitations

This research study is strictly narrowed down to match only with the defined objectives. In KONE's case the annual amount of raw ideas is already sufficient, and therefore idea generation process is excluded from the work. Also, other closely related topics, such as incentive system, resource management and organisational decision making system are excluded from the research work.

Creativity and curiosity are considered as very important components of successful innovation. However, the way how creativity or curiosity occurs is not addressed in this thesis, unless the connection to experimentation is found very close. Furthermore, the research work is only focusing on to the context of R&D, even though experiments would be applicable also for example in installation operations and in company's business model. From a geographical point of view the research is limited to take place from Finland. The practical experiments would have been useful to make in all R&D units physically, but this was not possible in the given time frame. To patch this geographical gap, the survey is collecting useful data from each R&D unit.

Lastly, learning is closely related to experimentation. Ultimately, experiments are made because people don't understand something well enough. How learning occurs, or does not occur, is addressed just briefly in this thesis. Once the experiment-driven culture has reached its target at KONE, the following step is to understand how learning could be more effective in the organisation.

2

The Link between Innovation and Experiments

People learn most efficiently when their actions are followed by immediate feedback.

-Stefan Thomke

2 The Link between Innovations and Experiments

For almost any business, innovations are the main instrument to generate growth and maintain competitiveness in the market (Brown 2010). As technologies and know-how develop faster and faster, the importance of innovation increases. (Ortt, van der Duin, Patrick A 2008) Every new feature in materials and technologies is bringing new opportunities and challenges that need to be solved again by innovative solutions. It is a never-ending loop in which no company can afford to stay still. Therefore, even the most conservative companies tend to proclaim how innovative they are, but in reality, almost every company struggles when it comes to innovation. To relieve this challenge, the world is full of research papers, articles and opinions about how innovation should be managed, but there are hardly any explicit right answers available as there is no mainstream solution for successful innovation. What recently is suggested by Ortt, van der Duin, Patrick A (2008), is innovation where activities are matched together with the business context.

Employees often delude themselves that innovations need to be large and radical in order to be called real innovations, but even the smallest and incremental innovations are needed in the daily business growth pursuit. According to Pisano (2015) division, innovations can be divided into four different main categories; Routine, Disruptive, Radical and Architectural Innovations. The ways in which innovations appear or are generated can be pure coincidence, but the probability and the quality of innovations can be improved with focused practices. In fact, an efficient innovation system should be reliable and repeatable. It is commonly known that the best-performing companies are able to integrate their business strategy together with their innovation strategy. (Brown 2010) Therefore, each company should have their own and tailored innovation strategy, and even more importantly follow it (Pisano 2015). A good innovation strategy not only produces innovations with higher probability, but also makes the company’s other operations more successful and more appealing – an innovative company is appreciated from outside among the customers and jobseekers, and from inside, the daily work is certainly more amusing for the existing employees. A recent study by Huhtala and Parzefall (2007) argues that innovations and work engagement go hand in hand, and that provides a situation for mutual benefit.

Each idea or vision has its special characteristics which originate from field of business, culture, people and available recourses. Therefore, the appropriate development approach is essential part of good innovation management (Gordon, Bieman 1995). Coming to the context, willingness to experiment is one of the key characteristics in an innovative organization, argues (Von Stamm 2003). Without any motivation and curiosity there is no reason to transfer the idea into an experiment.

Yet, the history has shown several stories how the pursuit of innovation, or lack of it, has yielded success or failure. Either way, it is a fact that all the companies need to adapt to the changing world and find their best practices to produce innovations efficiently and continuously. To offer a partial solution for this challenge, this chapter will introduce what is the connection between innovations and experiments, how they can be applied in R&D, and moreover, what benefits the experimental approach would bring to innovation activities.

2.1 History and Emerging Trends

Almost any innovation can pop up by a serendipitous discovery or through a highly goal-oriented process. For example, penicillin and x-rays were invented by accident, whereas the first functioning light bulb was a result of relentless experimentation by Thomas Edison. The unifying factor in the both examples is that the novel ideas could have not been born in front of a workstation – often the raw ideas require actual hands-on doing and experimentation in order to develop further. Despite this fact, the tendency in the late 20th and 21st century has been to do less radical and explorative experiments, and focus instead on formal planning and preparation.

As there is no one-for-all tool or equation to manage innovation in a successful way, you can find various strategies and approaches the ways in which companies are trying to do their best. One way or another, uncertainty is being feared and therefore companies are trying to bring predictability to their innovation practices through different contingency strategies. Today the topic has become more and more popular after we have seen how the small and rapidly growing companies are challenging traditional businesses with their radical innovations. The reason behind for the unexpected competitors is relatively simple – the start-ups are very development-focused and agile in their tasks, whereas the stabile corporations mostly focus on improving the profitability or fine-tuning their daily operations, on the expense of innovations. It can be argued that the innovation paradigm is under changes that are becoming faster and faster.

Professional innovation management has been conceptually present already from the late 19th century and the understanding about how innovation should be managed has remarkably evolved over the times. Depending on the source and framework, we are currently living in the phase of 4th or 5th generation of innovation management. Typical features for the current phase is that the development work is often parallel and integrated, and the external partners are becoming more and more important for the process. Some drawbacks of all the complex innovation systems are that the processes become challenging to manage and the basic functions, like research, are potentially endangered. (Ortt, van der Duin, Patrick A 2008) However, still the most common problem for many companies is that experiments are made too seldom and often too late. On the other hand, the development has been positive from the experimenter's point of view: Compared to the past times, nowadays it is easier, cheaper and faster to run experiments. Also, the variety of different kinds of experiments is expanding. (Thomke 2003) In other words, the common know-how and methods for making experiments are more efficient than ever before and therefore even the smallest "What if?" experiments should be easy to roll out. On top of that, even the innovation practices are becoming more and more consistent and standardised inside companies. Consistency in a company provides better integration and co-ordination, but the other side of the coin is that consistent systems are more resistant to adapt for the changes. (Ahmed 1998)

Experimentation is a form of problem-solving. Making an experiment involves always a chance of facing a mistake or failure. Thomke (2003) found out in their research that employees were afraid that words "Experiment" and "Mistake" would be considered as synonyms. This kind of interpretations and attitudes can cause severe challenges, especially if making mistakes is not supported in the organisation. The fear of making a failure has grown in the corporate world. Nowadays organisations are typically putting more and more effort for the planning and the atmosphere is rarely supporting spontaneous experiments. Obviously, the situation should be the opposite in the early stages of the innovation process.

Although, the only allowed exception is that experiments need some moderate planning before they can be put to action. The goal would be to make experimentation like breathing.

An emerging trend in the field of innovations is to open an interface for external users and developers around the world. By crowdsourcing a company can achieve significant benefits by collecting data, ideas or applications from the users. However, the focus needs to be well defined when making any experiments where external users are exploited.

Some experiments need to be implemented outside laboratory, in the real environment. In the past it was easier to fail without anyone knowing about it. Employees were ought to do less reporting and there was less supervision. Also, the communication and documentation channels were more limited, so the possible mistakes were less prone leak out. Today companies are under a spotlight – the whole world will know immediately if Google's self-driving car has been involved in an accident or if SpaceX's rocket failed to land successfully. Failure is an unavoidable option in each experiment. Managers need to underline this fact and remind employees to learn when they face an unexpected failure. So, or not, the basic dilemma has not changed over the times – the core question is that who will move the idea forward and validate it through experiments.

2.2 The Reason to Experimentation

Why should one make an experiment? Is there something valuable that can be achieved through an experiment? What happens if experiments are not made? These few example questions are the fundamentals when considering the reason to experimentation.

Innovations are rarely born fully mature. Very often the initial idea evolves into something more novel and diverse. The place where experiments are needed is somewhere between the initial idea and eventual product or service. Undeniably every initial idea is aiming to solve problem or to improve an existing feature. However, before the idea can be fully implemented, the uncertainty factors need to be solved one by one. Generally speaking, some of the ideas are simpler than others. In a fortunate scenario, a trivial idea is easy to pitch for management and soon after that it can be quickly implemented without a massive project. The more the idea becomes radical or complex, the more it requires uncertainty management, technology readiness level validation and regulation research.

The usefulness and the fundamental reasons about experimentation are widely described in the theoretical framework of the topic. The fundamental reasons to make experiments:

1. Find answers, cut uncertainty and learn

Humans are curious to understand the reasons behind a phenomenon and get answers to the questions that they don't understand in the starting point. Through the ages, making experiments has been the most natural way to find answers and proof theories wrong or right. Whether it was Galileo executing his gravity experiment or CERN colliding particles at the speed of light, in both examples the experiment has provided practical results to get answers for the questions. Preparing theoretical calculations and creating hypotheses can take tremendous amount of time, and in the end the experiment will show things really work. Therefore many professionals suggest to experiment early and often, and avoid massive planning without any experiments.

Questions and uncertainty go hand in hand. Experimentation is an effective method in uncertainty management – the uncertainties are easier to detect and cut away with practical experiments. Also, some idea variations are easy to test simultaneously with systematic experimentation.

Like brought out already earlier in the Introduction, the ultimate reason behind experimentation is to learn. Too often the research work focuses on getting results, but plain results are insufficient if the phenomena is not understood. Experiments are a practical and powerful research method to enhance learning in a research project.

2. Find unseen opportunities – evolve the idea

Ideas love experiments. The primarily function of an experiment is to get answers, but as a side product an experiment often yields new ideas on top of the original idea. The original idea does not possibly work as thought, but at the same time the experiment evokes new thoughts that could have not appeared without the experiment. A classic example of such invention is Penicillin where the original experiment did not succeed. The scientist found out that the reason behind the failure was contaminated petri dish, and now there was new kind of bacteria which lead to invention of antibiotics.

3. Cut development cost and time

Experiments are a great way to save time and money in NPD. This applies both to the ideas that succeed and to the ones that do not. The longer a project proceeds, the bigger the development costs become. Fast iteration is an effective way to learn about the idea in the early phases of a project.

Killing the wrong development tracks is not mandatory, but highly recommended. In the end a bad solution will be killed by the market if it has proceeded as far as that. Early detection of these wrong tracks saves both time and money, and the resources can be allocated to the more promising ideas. The most expensive way to make a first experiment is to make it with a ready product in the market.

On many industries, the development speed and ability to react to changes is the new weapon to succeed (Cooper, Kleinschmidt 1994). Project timeliness can be also improved by experiments. The time reduction in the front-end is mirrored to the whole project and therefore the TTM becomes shorter – early experiments increase innovation success and profitability in general, and the development costs become lower as well.

Naturally, making experiments is not always cheap. Such costs as equipment, materials, facilities, and engineering resources are easy to calculate but on the other hand the opportunity cost is extremely difficult to estimate (Thomke 1998). For example, how to consider a situation where a new business opportunity of 1M€ annual profits is estimated with an experiment. The experiment costs 10 000€ and the result is negative. Was the experiment profitable? So or not, experiments should be considered as investments – some of them will just cause costs, but at least the opportunity is explored. Every experiment has its price tag, and majority of them will be highly profitable in a direct or indirect way. However, the possible business value of the initial idea should be always considered before executing any experiments; an experiment about worthless idea is just waste of time and money.

4. Help decision making

Related to the time reduction aspect of experiments, critical decisions have to be made at some point when there are more options than available resources. Some development projects need to be eliminated and often the decisions are painful and complex. These decisions should never be made based on assumptions or guesses. Therefore, experiments offer great support for the decision making: should the idea be killed, suspended or put forward. Also, the maturity of an idea or technology is easier to validate with the help of experiments and thus the next steps are easier to decide. Lastly, experiments may bring unexpected opportunities for the decision making. Sometimes the decided option was not even on the initial list of possible development tracks.

5. Make work fun and appealing

Experiments bring also some soft values to the development work. Planning and making experiments is often something really tangible and fun, and experiments anchor the everyday work into real world. However, getting the employees to make the first experiment can be challenging. Most of the employees surely know that experiments or prototypes should be made, but in the end, very few are making an initiative and walking to the workshop. This is the dilemma of experimentation – the benefits are known but nothing really happens. Therefore, it is the managers that are responsible to encourage people go out and make experiments. Once someone is really making the experiment, he or she is certainly delighted about the work that brings variance to the everyday routines.

Lastly, the five arguments above are well summarising what benefits are potentially lost if experiments are not made. Surprisingly many businesses focus on killing the wildest ideas that could be easily explored with a few experiments. It would be useful to cognise the situations where experiments are immediately needed. Someone can present a raw idea, worth of millions, in a coffee room, but then someone else comes and kills the idea by saying that the solution is not possible – this is an easy way to avoid learning and success. However, as the technologies change and develop, some old and impossible ideas may become valid again after 20 years. For this reason, no idea should be immediately rejected. People are sensitive to other's opinions, and the threshold to make a mock-up, prototype or experiment becomes dramatically higher if someone says that the idea does not work.

2.3 The Goals When Running Experiments

Knowing the reasons why experimentation matters is highly important. Moreover, it is essential to understand what the goals when making an experiment are. First of all, it should be always remembered that an experiment is not an instinct value. In the worst case a poorly prepared and unfocused experiment can lead to results that are distorted or difficult to interpret. Negligence in this phase can cause that the phenomena behind the experiment becomes misunderstood and the development track is considered as worthless. How this can be avoided is to define learning goals, instead of focusing on getting fast results.

Like brought up already in the Terminology part, businesses are mainly focusing on the results. Managers expect to hear about results, not about things learned. Results are easy to assess and decisions can be easily justified through the numbers that results offer. However, this practice becomes problematic in experimentation. When a phenomenon is obscure or difficult to understand, it requires time and passion in order to be thoroughly understood. Therefore, it cannot be emphasised too much that the cornerstone of experimentation is to learn as much as possible, not to get fast results. However, knowing how to learn the best can be challenging, especially if the pressure is high to get results for management. Also, sometimes a project or an experiment is allowed to take only incremental risks, but at the same time it is expected to break new grounds. This is naturally paradoxical and should be avoided. (Andriopoulos 2003)

To make experimentation meaningful and effective, the process should start by defining the goals: What is the learning objective and what are the questions that need to be solved in this specific experiment? By focusing on this kind of strategic approach in experimentation, the elements of a bigger extent are easier to detect and implement. This applies especially into goal-oriented approach where the destination is known but the means are unclear. Thomke (2003) has listed seven factors that they believe affect learning the most in experimentation. The factors are: *Fidelity of Experiments, Cost of Experiments, Iteration Time, Capacity, Sequential or Parallel Strategy, Signal-to-Noise Ratio* and *Type of Experiment*. The impact of these factors is introduced in section 3.1.2 where learning is discussed on a more detailed level.

2.4 Designing a Good Experiment

The common message from all the professionals is that companies should make more experiments and less planning in the FEI phase. However, this may sound paradoxical when it is told that each experiment should be planned before the implementation part. These preliminary phases before making any experiments can feel frustrating, especially if one is not familiar with the best practices in experimentation. The level of uncertainty is often high when experiments are needed in the process, and therefore just even the starting may feel troublesome enough. How should one know where to begin when the problem is big as an iceberg?

Even the most complicated phenomenon becomes easier to understand when the experimentation process is split into clear and individual parts. Ultimately the objective of an experiment is to make us understand the relation between the independent and dependent variables: In an ideal experiment, we are manipulating the Cause and observing the changes in the Effect. The following steps are a customised composition for running a successful experimentation round. The selected steps are a comprehensive combination of best practices, based on all the suggestions that different sources are proposing. The process is illustrating how Edison could have started his light bulb development by using systematic experimentation. The examples are fictional, but describe a typical example of each step.

Detect a need for an experiment

This is the starting point for experimentation. Is there something that is not understood without making a trial? Is a prototype enough or is there a need for an experiment? What is the critical function or phenomena that needs to be learnt before making further experiments?
Example: Is it possible to make a metal wire to shine with electricity?

Split the entity into smaller pieces and functions

What are the pieces that are dependent and create the entity? There relations may become easier to understand and perceive if they are written on a canvas with connecting lines. Discussing with colleagues and sharing thoughts is essential at this point.

Example: Wire material, dimension, electricity current and voltage

Select one learning goal

Now the need and functions are mapped. What is the component that seems to be the most crucial and needs to be studied?
Example: How do different materials act with same current and voltage? Comparing five different materials.

What is needed? Prototypes?

The works starts to become more practical when the experimental design starts. Here the needed setup and materials are listed. Depending on the type of an experiment, a prototype, mock-up or sample group may be required.
Example: Different wires, power supply, oscilloscope, thermometer

Pick up one Cause-Effect relation

In order to reach the learning goal, the experiment should be simple enough. By manipulating only one variable at the time, the results are easier to interpret and thus learning occurs better.
Example: What causes the wire to melt? The correlation between current and diameter?

What can cause noise?

Noise stands for distortion in experiments. Error analysis is part of research work and it is good to know the possible reasons that can affect the results. Some of the noise can be avoided by proper planning before making the experiment itself. This saves time when the experiment doesn't have to be repeated because of too high noise.
Example: How pure is the used material? What is the humidity during the experiments? How to make the environment homogeneous?

Should it be a sequential or a parallel experiment?

Again, the type of an experiment dictates whether it should be implemented sequentially or parallel. In sequential experimentation, the focus is on sensitive and slow iteration, whereas the parallel approach is like a shotgun. Especially in the early phase of the process the parallel approach can offer faster results, but the drawback is that the noise can be high and some affecting factors are not noticed.
Example: Testing three different thickness from each material – a parallel approach

Formalise a hypothesis

The meaning of a hypothesis is often underrated. Hypotheses are a great way to tune up thoughts about the aspects that may affect the experiment. Learning occurs in two phases: Fist when the hypothesis is formalised and secondly when the experiment either proofs the hypothesis wrong or right.
Especially the scenarios where the hypothesis turns out to be wrong are fruitful. What caused the things act differently than we thought? Was there a mistake in the background theory and calculations?
Example: The copper wire will melt before it lights up

Execute

Finally, almost ten steps after the idea, comes the execution itself. Here again, part of the execution is to make sure that the noise is minimised and that the experiment can be repeated through a sufficient documentation. Again, it must be remembered to manipulate only one variable at the time, and make note about the findings before making changes.

Example: Connecting the wires to a power supply, running a set of experiments

Collect data

Data collection is either a parallel or sequential function to execution, depending on the type of the experiment. Error estimation is also part of execution and data collection – how accurate the results are and what can could have caused variation during the experiment?

Example: *Listing general observations and making notes about the current and voltage when the material is changing.*

Analyse and Learn – how was the hypothesis? Cause-effect relation?

Now comes the turning point of the experiment. Learning occurs the best, when the original hypothesis is compared to the results. It is essential trying to understand what caused the possible differences between the preliminary assumptions and occurred results. How did the cause-effect relation act? What can be concluded for the next round? Was the defined learning goal achieved and is something else still missing?

Example: Edison learned that no material makes fundamental difference in performance. Something else needs to be tried on the next round.

Iterate

Once the analysis is ready, it is time to move forward and make another round if something is still unclear. Typically, the iteration cycle is following: Trial - Failure - Learning - Correction - Retrial (Newell, Simon 1972, Thomke 1998)

Example: Making the same experiments in different environment, in different gas compound.

General comments

Every experiment should have a dedicated facilitator who makes sure that all the steps are completed before moving to the next phase. Also, being honest in experimentation is essential. Intuitions should not be presented as facts and the team should be honest about the details that they already know and which areas have the biggest gaps in team’s knowledge. A helpful method to assess the uncertainty is to give grades from 1-10 for the features that the team is examining. By this practice the team is more aware about the common understanding and then focus on the features that are known the least. (Hassi, Paju et al. 2015)

People and organisations are generally speaking risk averse. Therefore, the support for new initiatives should be high in order to get the fear of failure as low as possible when it comes to experimentation. In fact, there is no such thing as failure when making an experiment, unless the preparation is neglected. Nonetheless, virtually no experiment goes as planned and the results deviate always from the expected. This deviation is not failure, especially because sometimes the deviation can be positive from the expected.

Understanding the relation between prototype and experiment is important. What matters in prototypes is the progeny, not the manufactured piece itself. A prototype is not an experiment, but an experiment often requires involved prototypes in order to become a comprehensive experiment.

Bringing incomplete models to experiments is risky, but sometimes unavoidable. In Thomke's (2003) examples an incomplete model can cause a situation where an experiment detects a wrong problem or then an experiment fails to detect the true problem. In general, the quality of the prototypes and experiments should increase as the process goes further.

Lastly, if the whole experimentation framework is difficult to digest, it can be mirrored to running projects – they have many similarities, and some people or organisations are great in running projects. Projects and experiments have some similarities – in the beginning the goal is mainly known, but the path is unclear and requires different steps before the results can be reached. It may help if experiments are considered as projects. They may become easier to manage, if considered as projects. Nonetheless, the steps above are a wireframe for learning how to make a successful experiment. Each step is valuable, but on the other hand it is more important to start with something than discontinue the process because of getting too exhausted of planning. Like the pioneer of experimentation, Thomas Edison, has said, the real measure of success is the number of experiments that can be crowded into twenty-four hours.

2.5 Alternative Methods in Experimentation

There are more and more different ways to run experiments, but still only the end results, including learning, matter in the end. Not every experiment needs to be tangible and clinically implemented – often the quick and dirty option offers the most profitable results in the beginning of the process. It is good to understand that prototype, experiment and pilot do not stand for the same thing. Prototypes are tools that often are an essential part of experiment, but on the other hand making a specific prototype is a kind of experiment as well. Moreover, the context in general is defining what the role the prototype has in the experiment.

The variety of possible experimentation methods has grown dramatically, thanks to computers. Still in the 1970's and 1980's most of the experiments were not utilising the power or simulations, but since then the programmes have offered more and more useful option for mechanical experiments. Computer simulations offer an accurate, economical and repeatable way to do complex experiments. For example, the car crash experiments used to be very expensive and inefficient. The changes in car's chassis were virtually impossible follow during the crash, and one experiment gave a limited amount of data for the next round. With software simulations, several different simulations can be run simultaneously and the behaviour of each pillar can be followed accurately. Also, the digital prototyping technology offers new ways to make experiments. Complex assemblies can be designed without making any physical objects. In a digital world, the experiments are not bind to a certain location, and thus two teams from different continents can work on the same project. Anyhow, the best results in experimentation are often achieved with mixed methods. More generally, experimentation can be divided into two modes: simulations and physical experiments. Switching at the right time between these modes offers improved effectiveness of experimentation as the costs stay low but the results are better, argues Thomke (1998) in his research.

A good way to start the experimentation is to dismantle the idea into smaller pieces – canvases. By this method the workforce is easier to focus on one canvas at a time. (Hassi, Paju et al. 2015) Innovators need to separate the independent (cause) and the dependent (effect) apart from each other when doing an experiment. However, in the real world the environment changes all the time, making the testing more difficult and inaccurate. (Thomke 2003). Likewise, combining the sequential and parallel approaches brings another dimension to experimentation.

The following examples introduce different methods that can be useful to try in an experimentation process, depending on the context.

- **Verbal explanation** is something what we do almost daily. It is a simple way to try how people react to something. In a verbal explanation, the experimenter can for example describe a service or a function for a potential customer, and take notes about the comments that the target person is sharing.

- **Walkthrough** or **functional demo** are close to a verbal explanation, but they are naturally more tangible. Here the target person is leaded through the product or solution that can be for example a user interface, a mock-up or a space in general. What makes this an experiment, is the manipulation – by making small changes in the product, the effect can be observed, especially if the experiment is quantitative.

- Sometimes the solution or product does not have to be ready before it is introduced for a target group. **Smoke Test** is an experiment method where data is collected with a service that do not exist. This is a cost-efficient way to see how the potential customers react to the new product. However, special attention needs to be paid when preparing the experiment. A situation that should be avoided is such where a customer wants to buy the product immediately, but it cannot be sold.

- **Wizard of Oz** is close to a smoke test. In this experiment method, the backend of the solution is produced manually. For example, the product could be an intelligent speech recognition system, where the back end is just a human with headphones and keyboard. In Wizard of Oz the target group does not have to know how the solution is produced – only what matters is their reactions and comments about the product.

3

Best Practices: Experiments in Front-End of Innovation

If you want to find a prince, you must be prepared to kiss a lot of frogs.

-William H Matthews

3 Best Practices: Experiments in Front-End of Innovation

Most of the companies and organisations have defined methods and practices how they generate and treat new ideas. This initiating part of the innovation process is typically called either Front-End of Innovation (FEI) or the Fuzzy Front-End (FFE). This first part of the whole innovation process is playing an essential role in the big picture. It is stated that the key benefits of whole NPD are laying in the activities of the front-end. By doing the right things at the right moment, big savings can be achieved in the further NPD work. (Hüsig, Kohn 2003, Khurana, Rosenthal 1998) Irrespective of all the instructive examples about the effectiveness of experimentation, most of the companies are struggling when it comes to managing the innovation process.

This chapter offers a review to literature and to the best-performing companies, in the context of experimentation in FEI. What makes a process successful or not? What can we learn from the examples that different researches are pointing out? The principles may vary a lot, but the target is more or less the same – to have ideas and make them move forward as efficiently as possible.

3.1 Literature Review

To begin with, the purpose of the front-end of innovation is to produce raw ideas and then validate them quickly so that the best ideas can be detected and taken forward. Again, one of the methods to make this validation and idea development is to put the ideas under experimentation. In business, eventually it is all about profitability, and therefore the practices need to be well adjusted. In point of fact, Thomke (1998) highlights that experimentation can and should be seen as an economic process that is fundamental to innovation. Global and joint R&D brings it pros and cons to innovation management. Joint projects can be challenging to manage, but on the other hand the diversity of the employees and market environments brings added value to the equation. No surprisingly Criscuolo, Haskel et al. (2010) observed that globally engaged firms innovate more.

The early part of the innovation process is often described as the fuzzy part of the process. This fuzziness stands for uncertainty, chaos and unclear team vison in the new product development, and these reasons can be caused both by external and internal consequences. Zhang and Doll (2001) define that the fuzziness in the front-end of NPD can be categorised into three parts: customer fuzziness, technology fuzziness and competitor fuzziness. That is to say, that typically the team behind the idea is unsure if the customer would need the solution, if the technology is applicable and if competitors have already made a similar solution.

3.1.1 Components of Success

Time, quality and expense are often described as the variables of successful NPD, but even more importantly it should be understood what the correlations between these variables are and how each of them could be improved. An extensive case study, made by McNally, Akdeniz et al. (2011), focused on understanding the mediating factors of NPD processes and profitability. In the context of this thesis, their most important findings were 1) Investments on prototyping and testing increase speed to market 2) speed to market and product quality enhance product profitability 3) internal and external integration are both having a significant impact on product profitability.

Related to the third finding, Khurana and Rosenthal (1997) did a similar observation, as they found out that product success is strongly correlating if a cross-functional executive review committee is established. More generally, Khurana and Rosenthal (1998) argue, based their next case study, that greatest success in the FEI activities comes from the companies that take a holistic approach to the NPD. On their opinion, this means, that business strategy, product strategy and product-specific decisions are linked together. Holistic approach in FEI is also recommended by Kim and Wilemon (2002) who also emphasise to support and acknowledge champions and cooperate horizontally inside the company without forgetting to cooperate also with suppliers and intermediaries.
The holistic approach can be achieved either by a formal process or by a culture-driven process. Depending on the country and leadership culture, the approach should be selected by that. For example, in Japan the culture-driven approach was noticed to be better, whereas in USA the formal-driven process gave better results. What their study also points out, is that incremental innovations are born from standardised processes, but radical innovations were more likely to come from a front-end that is less explicit and gives more freedom for the ideator. (Khurana, Rosenthal 1998)
Surprisingly, what Khurana et al. do not highlight in the holistic approach is the meaning of experimentation. Matter of fact, this is a bit unexpected, or then the reason is, that the study does not speak out about methods in detail. Still, related to Khurana's findings, Pisano (2015) has noticed that too often the innovation strategies are not aligned together with the business strategies, causing inconsistency. Pisano (2015) suggests that a successful innovation strategy involves continuous experimentation, learning and adaption. Also, the model, made by Zhang and Doll (2001), suggests that a strong team vision is a main predictor of NPD success. From another perspective–outside technology industry–a case study that was implemented in a pedagogical environment for graduate students, gave clear results that experimental methods are improving the effectiveness of FEI. (Martinsuo 2009)

Time saving is part of successful processes. The shorter the TTM is, the better a company can respond to the needs of the market. In KONE's industry the TTM is not as essential as in consumer electronics, but on the other hand, once the solution is rolled out, it needs to be valid for the next 10 or 20 years. Therefore, the right timing is essential in addition to the general time saving. A case study, made by Cooper and Kleinschmidt (1994) found out that top 3 time savers in a project are 1) project organisation 2) up-front homework 3) strong market orientation. Especially the second finding is closely related to experimentation. Cooper particularizes, that cutting the corners and hurrying will reduce the project timeliness, and eventually not save time.

Lastly, in the components of success, comes the culture. Ahmed (1998) claims that culture is the primary determinant of innovation. Nevertheless, a culture just offers the ingredients for innovation, and the culture needs to be tailored to match organisations way of working. Again, in the context of experimentation, the ability to fail rises up. The culture needs to accept risk-taking at least in the front-end which is the playground of ideas. What Martins and Terblanche (2003) suggests, is that in addition to general ideating, the personnel should be rewarded for risk-taking and making experiments. They also mention, that even the employees themselves are associating experiments and risk-taking to creativity and organisation innovativeness. Not surprisingly, if experiments are purposely banned, that will kill the work environment creativity and innovativeness in general (Amabile 1998). Chasing success in innovation is not easy. In order to make a company more innovative, the challenges are not only managerial, but as well technical Thomke (2003) like we saw in chapter 2.

Lastly, the success is not always built by adding new process and ways of working. What is also needed is to detect the barriers of innovation and remove them. Again, in KONE's context such barriers from the report of Berg, Elfvengren et al. (2014) would be for example get rid of thinking about the old mental models, theories and existing products. Also, the risk-averse atmosphere and too modest thinking are hindering new and radical innovations. Moreover, what their report suggest as well, is to keep the innovation practices refreshed and sustain experimental culture.

3.1.2 Learning through Experiments

Saying that one should primarily learn from experiments is easy, but how that happens is practice becomes tricky and is easy to forget. First of all, the role of learning as part of experiment should be understood both by managers and the executing team itself. Secondly, the organisation should learn how to make learning more effective. Learning early is more valuable than learning later – this applies especially in manufacturing business where the volumes are big (Terwiesch, E. Bohn 2001).

To start with, Govindarajan and Trimble (2010) explain how learning should happen through experiments. Too often the experiments are specification-driven, meaning that there is only little of room for improvisation and learning. Instead, the experiments should follow scientific method, where the structured process focuses on finding solutions, not problems. What they claim, is that all experiment-driven learning is anchored to the scientific method.

Rapid feedback is essential in efficient learning. The smaller the research subject is and the more there are iteration rounds in experimentation, the better the learning outcome is. Totally logically, early learning is more valuable than later learning, says Terwiesch and E. Bohn (2001). Deliberate learning means often cumulative experimentation where each round produces cumulative learning data. What they also point out is that learning does not follow an immense amount of experimentation – at some point the quality and effectiveness of experiments will limit learning if experiments are poorly designed. Like mentioned already in section 2.3, Thomke (2003) suggests that learning in experimentation is affected by seven factors, presented in Table 1.

Table 1 The Factors That Affect Learning by Experimentation (Thomke 2003)

Fidelity of Experiments	The degree to which a model and its testing conditions represent a final product, process, or service under actual user conditions
Cost of Experiments	The total cost of designing, building, running, and analysing an experiment, including expenses for prototypes, laboratory use, and so on
Iteration Time	The time from planning experiments to when analysed results are available and used planning another iteration
Capacity	The number of same fidelity experiments that can be carried out per unit time
Strategy	The extent to which experiments are run in parallel or series
Signal-to-Noise Ratio	The extent to which the variable of interest is obscured by experimental noise
Type of Experiment	The degree of variable manipulation (incremental versus radical changes); no manipulation results in observations only

3.1.3 Different Views about Experiment-Driven Approach

Not all the sources point out the same things about experimentation. Nor does every employee inside the company see the need for experiments in a similar way. The prevalent context is a big factor–having an experiment-driven approach in FEI or in production optimisation makes a big difference to the best practices and general opinions and views.

Common Mistakes

Like we saw in chapter 2, planning of an experiment can be extremely difficult. The more complex the phenomena or cause-effect relation becomes, the more there are pitfalls for the implementing team. Typically, the complex problems are tried to tackle with sophisticated analytics and mathematical models, but the approach that Govindarajan and Trimble (2010) suggests is the opposite and counterintuitive. They recommend that instead of focusing on large spreadsheets, the team should have a *conversational approach* in the beginning before formalising any experiments. By that method all the expertise is utilised before anything is made and thus the experiment is covering better all the possible aspects. Here again, a well-prepared hypothesis is the key for the best results that support the learning goals.

Another typical mistake that Govindarajan and Trimble (2010) address is that people are diagramming their assumptions about actions and outcomes, but in this approach the big picture is distorted. How it should happen in experimentation is that people would start mapping the cause-effect relationships which consider subsequently more than just one action and outcome.

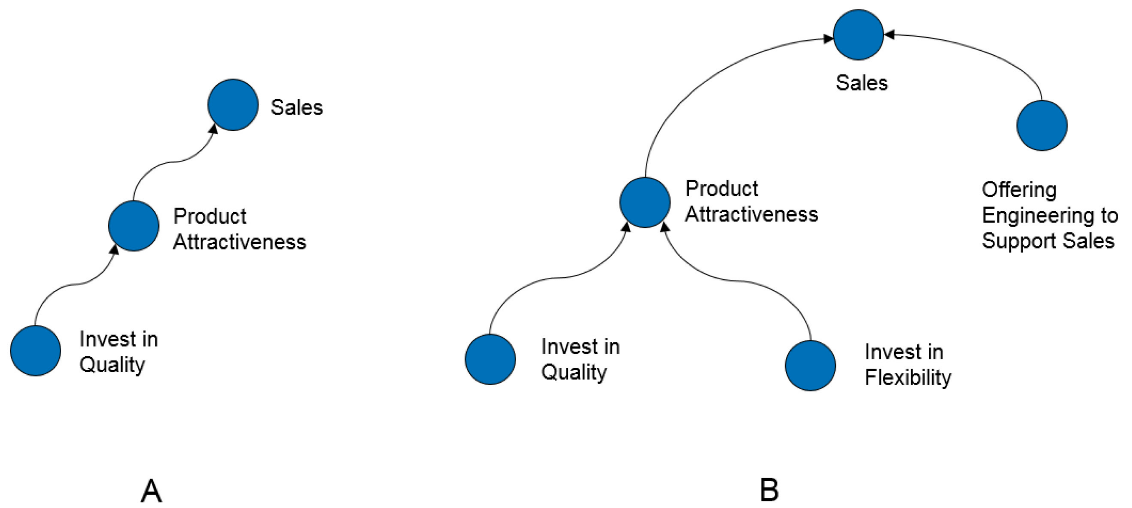


Figure 3 Initial hypothesis (A) is often too limited, and it is followed by Revised Hypothesis (B). An example by (Govindarajan, Trimble 2010)

The study of Eisenhardt and Tabrizi (1995) suggests that both compression and experimental approaches accelerate product development. The crux is that the approach should be selected based on the nature of the development case – if the process is predictable, the compression approach gives better results, whereas for the uncertain projects the experimental approach is more effective. *”Simply increasing the number of design iterations improves the odds of success and thus accelerates the process, particularly when predictable paths do not exist”*

What Makes an Experiment Good or Bad?

Fail fast and *fail well* are something what we hear more and more. However, strong opinions rise with these phrases. Some sources say that failing is not mandatory, neither should it be avoided, whereas other sources say that learning effect is stronger and more permanent when the learning comes from a failure. On the other hand, sometimes even the terminology is mixed when it comes to experimentation. A layman may associate the word *experiment* into something negative and painful, like animal experiments. Like mentioned already earlier, in Thomke's (2003) study if was found that some employees had avoided proposing an experiment to their managers because the experiment was considered as a synonym for mistake.

Flipsides

Most of the positive sides of the experiment-driven approach are already covered, but the approach has also some cons. First of all, every experiment requires recourses. Per se an experiment is meant to be profitable in the big picture, but if the guidelines are not followed the experiment can end up being waste of time or even worse, lead the development to a wrong direction. Secondly, some people may consider new experiments hostile, if they are related to their business field. As an example, the business line owner of highly optimised escalators could feel offended if somebody came and told that there is a new feature that should be experimented in the product. Like Terwiesch and E. Bohn (2001) puts it, experiments are deviation from what is currently believed to be the solution.

Sometimes it can be difficult to select the most suitable experimentation method for the approach. During the last 20 years experimenting has become more inexpensive and methods are wider than before. More iteration rounds possible to make in a short time, but the implementing team can have different views whether they should do tangible experiments or simulation experiments. (Thomke 2003)

Making experiments becomes often interdisciplinary. Different skills inside the company are partly needed, and this is the point where challenges may occur. The bigger the company, the more the units are responsible for their results, and therefore not every manager is delighted to lend their resources for an experiment. However, Dedicated Team & Shared Staff are found out to be the most effective way to implement experimentation and learn from it. (Govindarajan, Trimble 2010)

Future views

The views about how experimentation, and innovation more generally, are executed has some variance. According to Nobelius (2004) opinion, the trend is that in the near future the breakthroughs will be based on joint efforts from loosely tied networks. These networks consist of smaller players whose drivers are closer to a pure interest than profits. The trend is present already now as companies are opening their NPD interfaces for external and individual developers. An extreme example of external developers is Apple whose developer community is actually paying annual fee so that they can be part of the joint development projects (Berg, Elfvengren et al. 2014). Likewise, all kinds of hackathons and open innovation challenges are becoming more and more popular, as companies have noticed that these kinds of events are highly productive and broaden the business sight.

Key Benefit

Naming the key benefit of experiment-driven approach becomes tricky. It could be said, that the benefit is dependent on who you ask – a project manager, CEO and supplier will have most likely different opinions about the meaning of experimentation. Most likely the project manager would be interested in finding the right answers as fast as possible, whereas CEO would see experiments as an effective way to find business growth. The supplier potentially see that their operations could become simpler through improved processes. Also, the scientific studies are pointing out different findings.
The case study by Eisenhardt and Tabrizi (1995) focused on understanding the ways in which the adaptive processes could be accelerated. There, the experiment-driven strategy was a key method to shorten the product development time. In turn, Sørensen, Mattsson et al. (2010) underlines, that experiments are, and will be, the central research strategy for innovation. They also suggest that so far the experiments have been undervalued in innovation research. The longer the project proceeds, the more important the uncertainty management becomes, and experiments are a great way to reduce uncertainty:

"Uncertainty is defined as the inability to assign probabilities to outcomes and risk is regarded as the ability to assign such probabilities based on differing perceptions of the existence of the orderly relationships or patterns." (Zhang, Doll 2001)

To sum up, the key benefits of experimental approach are:

- Reducing Uncertainty
- Generate Learning
- Cut Development Time and Expenses
- Improve Prove Product Quality
- Produce and Evolve Innovations
- Generate Business Growth

3.2 Success Stories of Experiment-Driven Approach

Depending on the industry and type of business, some companies are from the outset more experiment-driven than others. For example, the pharmaceutical industry is strongly leaning on systematic experimentation – its business as usual for them – and on the other hand they have limited amount of other options to replace experimental approach in their R&D. The set-up becomes totally different when talking specifically about experiment-driven innovations – such actions that are aiming to make a breakthrough with the help of experiments.

This section introduces some describing examples how experiment-driven approach has yielded success in the front-end of innovation. Some of the solutions are invented partly by accident, whereas the others are results of relentless and structured experimental approach.

To begin with, the leading and iconic outdoor fabric **Gore-Tex** stands for experimental innovation. The inventor, Bob Gore, had executed purposive experiments with PFTE polymer for several weeks. Repeatedly the material kept on braking into parts, and Gore became frustrated. Due to this frustration, one evening he rapidly yanked his wrists apart while holding the heated PFTE rod, and something unseen happened – the rod did not break but stretched to full length. A new surface was invented by accident and later Gore-Tex became a huge commercial success. (Harder, Townsend 2011)

Next, the ramp-up of new products or product categories is inevitably risky and expensive. Based on weak signals from western market, an Indian automotive company **Mahindra & Mahindra** decided to design and deliver a new SUV to Indian market. Company's general inexperience about NPD and their frugal engineering department faced a challenge that eventually lead to several innovations. The company took an experimental approach with moderate investments. First, they designed smaller car that was just a test bed and a way to learn about designing a SUV. The experiment was used to test the company's ability to design and manufacture such parts that were previously outsourced. What Mahindra & Mahindra also learned was how to collaborate with suppliers. Previously they just had dictated their needs to suppliers, but now the supplier was pleased to offer their expertise and make the end product better.

Despite the small investment and short development time, the whole project became a significant success story – the final product that was designed based on the learnings of the initial experiment became 30-40% cheaper than competitor's similar vehicles. The experimental approach was considered as a key factor in the process that eventually offered an improved development strategy, lowered manufacturing costs and reinvented business model. (Govindarajan 2016)

The same article presents an example of almost failed experimentation: In the early 1990's **IBM** was strongly developing an idea that we nowadays call Internet of Things. Their low-cost and low-risk experimentation did not succeed, as their research area was too wide and isolated business units had fundamentally wrong approach, as they were almost establishing a new business, not making research. Years later, the structure was reorganised, and dedicated teams were formed. The new approach focused on patient experimenting which often began as in-market experimentation with customers. Now, two decades after the initiative, the IoT business has become a billion-dollar business for IBM.

The European nuclear research facility, **CERN**, has been actively pushing the limits of science and technology for more than 60 years. The following description is based on author's own experiences in CERN, during three visits in 2013-2015:
In CERN, most of the phenomenon are first discovered or believed to be known on a theoretical level, but each and every theory must be verified through experiments. The findings between the research projects are regularly shared among CERN's staff, to ensure that gained knowledge and learnings are utilised. Everything is public and people are not withholding any information from each other.
What CERN is less known for, is all the inventions that they produce as side products in their research. The challenges in CERN are often so extensive that the researchers have to develop multiple solutions that formalise together the needed solution for the initial challenge. What often happens is that these pre-solutions are already novel breakthroughs that just are side products of the process.

The older the business becomes, the more difficult it is maintaining the innovativeness inside the company. The American **3M** is a good example how they manage to stay innovative and produce new products on a regular basis. Quite descriptively 3M has been able to reinvent a simple product like sand paper for several times, and in fact the company has been able to reduce the sanding time by up to 50%. Experimentation has been always highly important for 3M and most of their major innovations are born through systematic experimentation (3M Company 2002). More generally, the driver or innovation at 3M is to sponsor creativity, and in practice they foster the creativity through six drivers (Filipczak 1997):

1. Vision: to be the most innovative enterprise in the world
2. Foresight: to make sure that the market is ready for the idea
3. Stretch Objectives: 30% of revenues must come from ideas that are less than 4 years old
4. Empowerment: 15% of time must be used to develop and work on own ideas
5. Peer Recognition: organising innovation awards at 3M
6. Communication & Networking: encourage people to meet others from different departments and disciplines

3M has a tolerance for tinkerers and a pattern of experimentation that led to our broadly based, diversified company today.

-Gordon Engdahl, retired vice president, 3M Human Resources (3M Company 2002)

4

Innovation at KONE

By establishing a dedicated Technology & Innovation unit we will speed up our development in a changing business environment.

-Henrik Ehrnrooth, President & CEO
KONE Corporation, 17.09.2015

4 Innovation at KONE

KONE was established over 100 years ago in Finland. Over that time the company has evolved dramatically from an electric motor repair company into a leading people flow company. Several acquisitions have brought to the company new employees, culture and know-how from all around the world. The operations became international already in the late 1960's and nowadays the major R&D units are located in China, Finland, India, Italy, Mexico and USA – not to mention all the global maintenance sites. KONE's growth hasn't been always the same. In terms of headcount and sales, the growth has been significantly steeper during the past 20 years, especially in the Asian KONE units.

When it comes to innovation at KONE, all the R&D units are equally important. At KONE, the basic view is that ideation and innovation belongs to everyone, regardless about the unit, team, manager or one's experience. To offer a solution for this philosophy, innovation management bought 2009 an online tool for harvesting ideas from each unit. This comprehensive tool would allow anyone to share an idea in an easily manageable form. Since then anyone has been able to post their wildest ideas into the tool and get supporting or questioning comments from colleagues around the world. However, this innovation tool is just an idea harvester and a transparent platform for communication. To make the ideas really fly, the innovation process needs to be defined and implemented elsewhere.
In addition to the tool itself, each unit has their own Innovation Manager who is the local contact person in all matters that are related to innovation. These Innovation Managers are also the persons who can find and design the best practices inside the unit, so that the cultural aspects are taken into account.

To put it simply, KONE is looking for two variables in an idea: either the idea has to have some business value or then the idea needs to be technology-wise novel. The best ideas are patented innovations - a combination of these both variables, and the solution is profitable and possible to protect from competitors. However, the people flow industry has its own special features when it comes to end products. The service and maintenance business is open for all the certificated companies in the market and even the spare parts have to be sold for any competitor, if needed. Virtually any maintenance provider has to be able to know how to repair elevators, escalators and building doors, regardless about the original manufacturer. The best way to protect these visible solutions is patenting. With a patent a company can protect a solution for many years and obtain significant benefit due to a solution that the customer values. Some ideas can be even just patented so that the patent is hindering competitor's possibilities and opportunities.

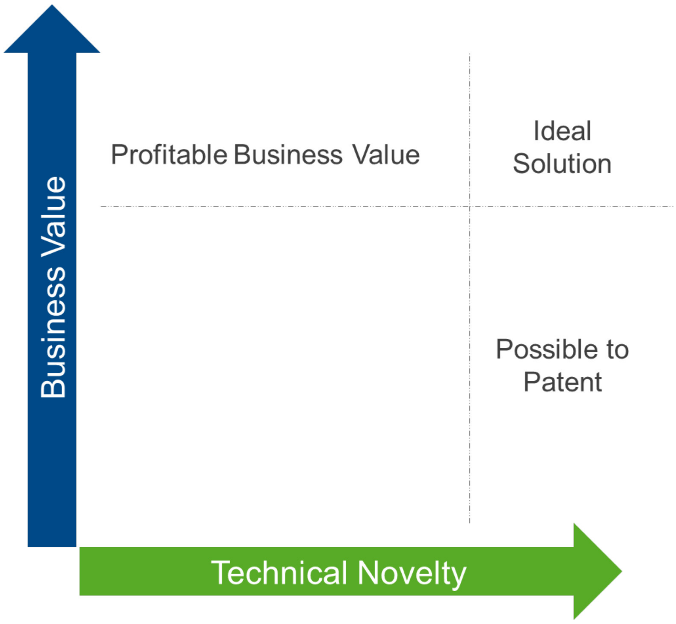


Figure 4 Idea becomes feasible if it has enough of Business Value or Technical Novelty

Possibility to protect an idea by patenting is the foundation of the industry as the solutions need to be such that any operator in the market can repair an elevator or escalator, regardless the manufacturer. All this is due to the safety and the fact that a typical life span of an elevator is several decades, and any company has to able to maintenance the products. Thus, the competition also in the maintenance and service business is also tight, as the competitors are able to challenge KONE's service business. This setup emphasises the importance of the R&D and innovations, as the all the sold products and solutions have to be safe, long-lasting and unique. Once a product is installed to a building, it is expected to work for decades, and therefore the business is totally different than for example the mobile phone business where users are changing the device almost yearly and competitors are not competing about the service business at all.

4.1 Innovation Strategy

KONE wants to maintain the good market position they have gained and avoid the pitfall of not renewing the company to match with the time. Like mentioned earlier, innovation activities improvement is part of KONE's current core development areas. The current innovation strategy was updated a few years ago, and in general the innovation strategy is positioned fourth in the hierarchy of the whole company (Figure 5).

Figure 5 Innovation strategy is positioned fourth in KONE's hierarchy

This Innovation Strategy is split into six sub-parts:

1. Define how innovation will support KONE achieving its business objectives
2. Engage all of KONE for innovation opportunities
3. Define areas of partnering and attract partners to accelerate innovation
4. Drive focused innovation efforts that go beyond individual business units and functions
5. Balance KONE innovation efforts across business areas and types
6. Strengthen KONE innovation capabilities

Especially the sixth part is related to this thesis, as the common goal is to make the idea implementation more effective in the early stages of KONE innovation process. To support the innovation strategy, KONE has defined 10 focus areas that help defining what KONE should bring to the market in the medium and long term scope.

4.2 Innovation Process Description

KONE innovation process consists of three individual and consecutive parts; Front-End of Innovation, Blue Boxing and Develop Solutions (DS). The latest update in the process has happened on spring 2016 when the new Develop Solutions process was released. All together the innovation process is officially called *Solution Creation Process* (SCP). There the two first parts are called together as the *Concept Development Process* and they are followed by Develop Solutions process, also known as *Purple Project*. A parallel track to Blue Boxing and Develop Solutions is a *Change Request* (CR), where a minor change request is implemented to an existing solution. In terms of numbers, most of the ideas belong to the CR category, but when the idea is totally new, it follows the innovation process to the very end.

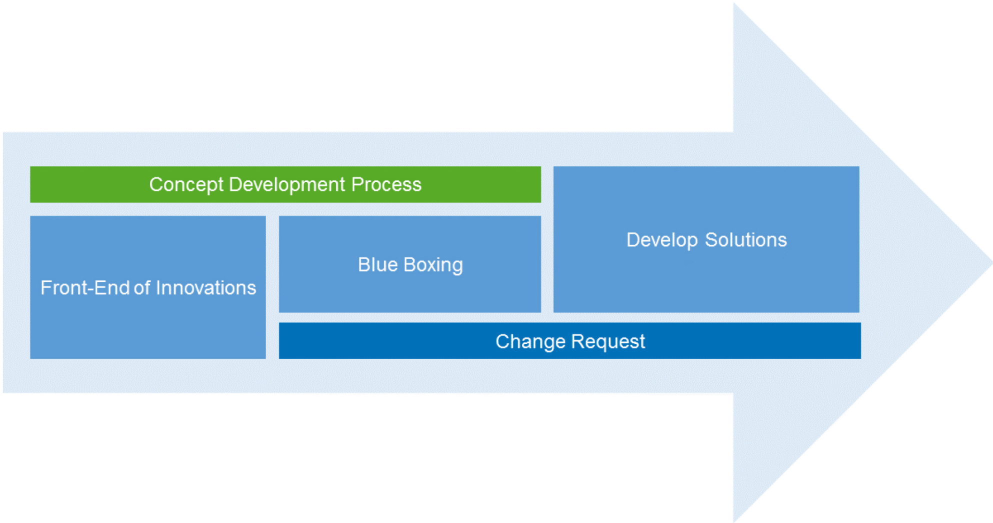


Figure 6 The Solution Creation Process; from ideas to solutions

The purpose of the process is to detect the most promising ideas and allocate recourses for them. The **Front-End of Innovation** is the playground of ideas, where everything is more or less allowed. However, in order to move forward, the idea needs to be attractive – either it is technologically wise novel or then it has promising business potential. Either or both, the idea is then proposed for the next level, called **Blue Boxing**. In this second phase the idea becomes a project and the purpose there is to make a comprehensive research if the concept would be mature to become a profitable solution for the company. In the Blue Boxing phase the concept goes through several rounds of questions and during that process it is either withdrawn or then it survives through all the questions which are trying to verify the technology readiness level, business case, and at the same time reduce the uncertainty. If the concept passes through all the questions, then it becomes a **Purple Project** where a company-wide nominated team is composed. The task of this team is to prepare and deliver the concept to the market.

The innovation strategy, presented in the beginning of this chapter, is the foundation of KONE's Innovation Process. Like at any other company, also at KONE the process starts from the front-end where innovation management and corporate strategy have designed different tools for idea creation. In practice the initiatives for the idea creation process are:

- **Innovation Strategy**: e.g. new digital services
- **Comprehensive Insights**: e.g. urbanisation, population aging
- **Impulses**: e.g. YouTube, newspapers, discussions
- **Innovation Toolbox**: e.g. Hackathons, Innovation Challenges

At KONE Innovation Management, the common view is that most of the raw ideas in the company are generated through the company's strategic insights or random impulses that virtually come from anywhere–from newspapers to coffee table discussions. Once the ideas are generated and presented, comes the evaluation. The evaluation process is naturally an important function of the innovation system. Depending on the category where the idea belongs, eventually two people have the power to either ignite or kill the idea.

Each product category has nominated *Champions* and *Owners*–the Champion is the technical professional of the category and the Owner is the business controller. The decision making should base on facts, but the needed information is not always available due to insufficient experimentation FEI, and therefore some ideas have to be evaluated with very little of information. Here, the desired state would be to get more and faster information about the idea, so that the evaluation could be fairer. The effectiveness of FEI is strongly correlating with the whole TTM that KONE wants to reduce. Hence, the faster the promising ideas are detected and put forward, the better it is for the whole process and TTM.

Once the idea is generated, then starts the sharing and processing phase. Typically, this means that the idea is put to Innovation Tool so that it is visible and open for comments by anyone. Also, contacting the patenting team is often done in this phase so that the technical novelty of the idea can be possibly verified. However, the key stake holders in the innovation process are:

- **Idea Presenter**: The person(s) behind the idea
- **Champion**: The technical expert from the field where the idea belongs
- **Owner**: The monetary support and business understanding for the idea
- **Innovation Manager**: The local innovation manager
- **Project Manager**: Once the idea becomes a project, it is led by a project manager

4.3 Challenges & Opportunities in Global R&D

The global R&D units bring their strengths and weaknesses to the innovation system – the employees are closer to the end-user and there are more people with different backgrounds, but on the other hand the joint product development becomes more challenging when all the colleagues are not in the same time zone.

Due to the historical aspects, one major challenge in the global R&D is probably the attitude that the R&D in Finland would be the leading R&D unit, although all the units are equally important and needed in the big picture. The challenge especially in the Asian culture is that some employees are unsure how they should present their ideas and are they allowed to try them without any permission. In the context of FEI and experimentation this is naturally an obstacle, and the rules of FEI needs to be sharpen both for employees and their managers. The opportunity and enabler here is the Innovation Manager network that KONE has. Each unit has an Innovation Manager who is virtually an ambassador of the latest trends in KONE innovation.

From the communicational point of view the global operations are naturally challenging as well. There are over 1000 R&D people–how to deliver the message for them, and how to make sure that it is obeyed? However, common rules are good for no one, and therefore each Innovation Manager are allowed to tailor their methods to match with the unit’s culture and practices. All in all, managing the innovation on a global scale is a demanding task where the actions need to be deliberately thought before implemented.

To sum up, the current challenges are that often the ideas presented too early without proper background checking or experimentation. Making decisions is not easy for the champions and owners, as there is no evidence about the idea whether it would work or not. This also causes that the processing takes longer than it should be, and the idea presenter may think that his/her idea is not good at all. Currently it is the presenter’s responsibility to make sure that the idea can reach the first step in the innovation process, but at the moment only a few people in the company are active enough to make this happen. The opportunity that the global R&D offers is the diversity in the ideas, technologies, partners and local understanding about customers' needs. A vast amount of experimentation is needed in order to take most out of these opportunities.

4.4 Building Up Experiment-Driven Innovation Culture

With the ongoing innovation process development task, KONE is aiming to make the practices more productive. The findings and suggestions from this particular thesis are part of the possible renewal actions, especially when it comes to experimental culture.

First of all, it is good to ask that what makes the culture experimental. Currently the mind-set is to design safe products and test them relentlessly. However, if there is no existing culture of experimentation, it may need to be built by structured communication and close steering. Once the community starts to adapt the general mind-set about experimentation, it may become part of general R&D culture and common procedures at KONE. Some individual engineers, like the inventor of UltraRope, are already embodiments of experimental culture, and their skills, principles and working methods can be used as an example for the R&D society. Nonetheless, the pitfall here is that the best-preforming individuals are seen too skilled and distant, and the end result may be that no one dares to join their way of working.
The next chapter studies how the current arrangements support experimental culture on a practical level. Without facilities, resources and organisational allowance any experiment is difficult to execute. If these are found not to hinder experimentation, then the culture itself should be easier to build.

5

Case Study: Assessing Ease of Experimentation at KONE

It is absolutely essential that one should be neutral and not fall in love with the hypothesis.

-David Douglass

5 Case Study: Assessing Ease of Experimentation at KONE

Based on the preliminary discussions with KONE innovation management, their empirical observation has been that KONE R&D people, at any unit, are doing too few experiments. It is not known where the problem originates from–is the threshold to put hands dirty too high, or are there too little recourses or do the employees even know the essence of experiments, or where and how they can physically make experiments?

To get answers for these questions, a combination of hypotheses and a case study methods was designed. In terms of the whole research it became fundamental to understand if the findings from literature, related to the difficulties of experimentation, could be also found inside KONE organisation's resources or ways of working. Like mentioned earlier in the Literature Review part of this work, most of the companies are somewhat aware about the benefits of experimentation, but eventually very rare of them are capable to put the awareness into action. In order to find the KONE-specific bottle necks about the ease of experimentation, the case study was expected to underline some of the problems and show whether the hypotheses were true or false. The case study was split into two parts, where the first part was more qualitative and location-specific and the second part was global and quantitative.

Part one, three field experiments in Hyvinkää, was the qualitative and mostly the empirical part of the case study. It focused on making observations about the features that are present in the early stages of the Innovation Process. In practice this meant that new ideas were generated and the goal was to push them forward as fast as possible without forgetting to make some experiments. These three experiments were testing how the internal collaboration currently works and what could be possibly improved–in practice making a smoke test for the innovation process from three different angles. The empirical part took place only in Hyvinkää facilities.

The second part of the case study was a targeted online survey for all the people who had an approved idea in the Innovation Tool. The recipients of the survey were precisely the people who should have made some kind of experiments with their approved and therefore ideas that seem to be promising. Therefore, it was seen fruitful to send them a targeted survey which would aim to find how the most active people in the R&D feel about the current processes and ways of working.

As a combination, the field experiments and the survey were expected to give a comprehensive understanding about the ease of experimentation at KONE, and on the other hand, test the hypotheses. In addition to this, the case study, or its findings, were presumed to give practical recommendations for making improvements for the whole innovation process and practices.

5.1 Hypotheses & Background Concept

The hypotheses were formulated in the early part the research work before the case study began. The hypotheses were composed through the general observations by the author and through the discussions with KONE innovation management representatives. These findings were combined together with the insights that the literature was addressing. All together these findings were assessed and the most relevant of them were selected to be a set of hypotheses for the research work.

H1 *The usefulness and effectiveness of experiments is known at KONE, but no one is putting pressure to really make experiments about an idea*

This hypothesis is partly covered already by the fact that KONE decided to make a research about the topic. The company is aware that innovation should involve more employees than currently. Also, one of the recently defined goals is that innovation, experimentation culture and rapid learning cycles should be strengthened in all KONE units. The latter part of the hypothesis refers to an assumption, that the current practices are not designed so that experimentation would be an intent part of the whole innovation process.

H2 *The business case of experiments is not adequately understood at KONE*

Here, the business case refers to the cost and value of experiments. The theory behind this hypothesis is, that according to several research articles, most of the companies do not understand that what kind of savings the early investments to prototyping and experimentation can offer. Often the companies only see the supply and labour cost that the experiments require, but the return on investment is fuzzy and difficult to determine.

H3 *Experiments are often seen as mechanical tasks, although the variety and nature of different experiment methods is growing*

Historically wise, KONE solutions have been mostly mechanical. Therefore, the common mind-set may guide people's thoughts towards mechanical and carefully prepared experiments, even though the variety of solutions and experiments is continuously broadening.

For example, many solutions are nowadays related to user interface where the user and its reactions are in the focal point, not the involved prototype itself.

H4 *The facilities and available resources are premium at KONE, but known poorly*

Having the basic facilities and sufficient recourses is essential in the ease of experimentation. In other words, getting money and accessing workshops should not be too difficult or time taking. The hypothesis stands for an assumption that the needed recourses for experimentation are not difficult to reach, but on the other hand these resources are not well promoted for the employees.

H5 *There is too much planning, at the expense of actual doing*

Again, many sources underline that corporations typically focus on planning and eventually the actual doing is forgot. The reason can be either cultural or then managerial. Notwithstanding, no ideator's passion should be hindered with unnecessary applications and manager approvals.

H6 *The bottle necks of experimentation are not caused by resources – the major barriers are either imaginary or come from insufficient steering in the innovation practices*

Closely related to the Hypothesis 4, the resources at KONE are believed to support experimentation in general. However, if the people think that they are not ought to make experiments and neither the innovation management is not encouraging to experimentation, the end result may remain insufficient.

H7 *The nature of the business is hindering the culture of experimentation*

Safety is the foundation of the elevator and escalator business. Whatever the final product is, it needs to fulfil the stiff safety regulations that are set to the products. This hypothesis is to say that KONE employees' creativity and curiosity is limited because of the regulations and safety aspects. As a result, the curiosity to make daring experiments is hindered, even though the FEI part of the process would allow the employees to think and act without any limitations.

5.2 Focus Areas and Defined Goals

The focus areas and goals in the case study are closely linked together–by focusing on specific pain points, e.g. why people are not making experiments, the goals are easier to achieve and also the results are possible to decompress and interpret. From the company's perspective, the findings and practical recommendations are the most valuable part of the whole research work, as KONE is truly willing to improve their innovation practices towards more effective and quicker process.

The focus in the case study is primarily to get a global overview about the present culture and ease experimentation at KONE. The secondary, though not inferior focus area, is to make observations and suggestions of improvements through real field experiments.

5.3 Implemented Research

As amusive as it is, the implemented experiments were planned for the case study. The task was to find out by experimenting what the possible bottle necks are in the front-end and what could be done differently. First, the case study research focused on gaining quantitative results through a targeted survey that covered all KONE R&D units. The second part of the case study explored the ease of experimentation on a practical level in KONE premises in Finland. Executing a similar field research in every unit would have been very fruitful in order to get a comprehensive understanding about the situation. However, the field research had to be narrowed down to Finland because of schedule and resource limitations.

The quantitative survey and qualitative field experiments compose together a sufficient amount of data that can be then mirrored to the hypotheses and findings from literature.

Table 2 All the hypotheses were covered by four different study methods

	Survey	Case A	Case B	Case C
H1	X		X	
H2	(X)	X	X	
H3			(X)	
H4	X	X		X
H5	X	X	X	X
H6	X	X	X	X
H7		X	(X)	

5.3.1 Survey

Description & Background

Making a survey was one of the initial ideas to get data for the research. Surveys have their pros and cons: a survey without a specific angle and target group easily becomes useless, but if the survey is well designed, it offers useful quantitative data with low effort. The thought was to use survey if a criterion matching target group would be found.

KONE Innovation Tool was launched in 2009 and since then R&D employees have been able to submit any kind of idea to the online tool, regardless about the culture, working experience or other possible limiting reasons. Category professionals go regularly through the ideas, then select the most promising ideas and mark them as *approved*. This approval is the first official green light for the idea, and it means that the idea should be taken forward in a way or another. However, after the approval comes the critical part – will anything happen after that? As we started browsing at this focus group, it became obvious that too many ideas were stuck – there were 424 approved ideas in the Innovation Tool which had not significantly proceeded forward after the approval. This leads us back to the original issue: An idea is only a beginning, but it needs to be exposed to experiments in order to learn more about the subject.

Scope

It was decided that these 424 approved ideas represent perfectly the problem field for the research. The sample was big enough and it covered all R&D units, so that it could offer valid data. The survey would ask why the idea development has stopped and how the employees see the KONE innovation process in general.

It was found out that there are in total 254 different employees behind the 424 approved ideas – meaning that some employees have more than one approved idea in the innovation tool.

The survey started by asking respondents unit and working years at KONE. In addition to that, some mapping background information was collected about the approved idea. Then came the conditional part where the respondent was directed to the next questions, depending whether the idea had proceeded after the approval or not. The questions there were designed to harvest data about the possible bottle necks.

From: Hannes Kallioinen
Subject: Does your idea count? Invitation to Survey about ideas in Innovation Tool

---

Dear Idea Presenter,

We have currently over 400 approved ideas in our Innovation Tool. You have presented at least one of them – Great!

At the moment we at KONE are working on strengthening the experimentation culture as a natural part of innovation process. Therefore we are willing to understand how the innovation process could be improved and what the current bottle necks are, especially when it comes to experimentation. Idea generators with approved ideas are one significant target group for this study.

So, please join this survey at: https://www.webropolsurveys.com/S/A568040273AFD229.par
It will take 7-10 minutes. It can be accessed from network and from any device. Answers cannot be connected to individual respondents. The survey is open till Friday 10th of June. By answering the questions, you will participate in improving the KONE innovation process.

Please note: If you have several approved ideas in the system, please select only one of those while answering to the survey. You can find all your ideas from here.

We appreciate your time and effort – and thank you in advance!

Hannes Kallioinen
Innovation Management sidekick / Master's thesis worker

Ari Hänninen
KTI Innovation Manager

Figure 7 The email invitation to the survey

Observations

In total 240 employees received the invitation to the survey, and 59 of them gave a response. Thus, the response rate became 24% which needs to be concerned sufficient in the big picture, but unit-wise the sample became too little to make reliable comparison between five units. Surprisingly many people were sharing their thoughts and comments in the open text questions, and these answers also turned out to be very useful and valuable for the research in general.

The key findings are presented in chapter 6 and the original survey as a whole can be found in the appendices.

5.3.2 Case A: Radical Single Idea

Description & Background

This anonymous idea, called "A", was invented during the early stages of the master's thesis writing process. The idea was presented for KONE representatives which immediately thought that the idea is relatively radical and unseen in the company. Nothing similar had been ever thought of, but the business potential of *A* was immediately recognised and the involved people became excited to see if the idea could be experimented somehow.

The phenomena behind the idea is easy to understand but difficult to imagine if it works or not. The idea is fully mechanical and it can be easily experimented on a rough level with a simple prototype. However, even the simplest prototype of the idea is such that it needs to be outsourced – KONE's prototyping workshop is not capable to manufacture such a prototype with the existing equipment. Another challenge in the idea is that there are no category owners for the idea in Finland and therefore the baseline of knowledge is very low.

This Case A offers a good case study about the ease of experimentation at KONE Finland. The idea challenges many aspects of NDP and possibly addresses answers to many of the hypotheses.

Scope

The scope of this experiment is to collect organic experiences and observations how easy, or challenging, it is to propose a radical idea as a new and unexperienced employee inside the company. All the discussions, comments and other general observations are considered as a material that represents the ways of working in KONE Finland. As the idea is relatively radical, it does not fulfil the safety code of the industry. Also, there are several safety aspects that are related to the idea, which makes the experimenting process interesting – does the company's processes and people support to develop an idea which is undeniably too radical to enter the market with the current regulations?

Lastly, the scope with this case study is to test how easy it is to proceed with the idea without any support from colleagues. In practice this means that all the emails are sent without further explanations or putting managers to email's cc. If the intentions of a rookie are questioned, it is a clear sign that the ease of experimentation has room for improvement.

Observations

The idea was warmly welcomed when it was coincidently presented for KONE's Innovation Manager. The first comments were that the idea is really interesting, though difficult to imagine working without a real prototype. Therefore, a while after that it was asked to make a quote to a company that could manufacture a simple prototype. The cost estimate for the prototype was a few hundred of euros and it was considered as a tiny amount of investment even though there was no evidence that the idea could work. Nonetheless, the fact was, that if the idea would work, it could save millions of dollars through the simpler design and better serviceability. So, the preliminary observation was, that money is not an issue in experimentation, at least in this case. Soon, a CAD-professional was asked to make drawings so that the prototype could be ordered from the supplier. The prototype arrived a month later and a simple experimentation round was made in workshop environment. Still, the applicability in a real environment was fuzzy, and therefore further experiments needed to be made in Tytyri, KONE's testing facility close to Hyvinkää.

Finding the right contact person from Tytyri was easy, and soon a date for experimentation was booked. Everything went smoothly in the preparation of the experiment and people were helpful, even though they did not know what the idea was and who the people were behind it. Similarly, the experiment itself at Tytyri was easy to implement and the local staff there were positive and willing to help if anything was needed.

Another observation from Case A was that experimentation can be fun and attract colleagues. Initially the idea was developed only by one person, but during the process many colleagues joined voluntarily the ideation and experimentation events which was a positive sign. The idea development of case A may continue after this thesis, but already the general observation was, that nothing was hindering experimentation in this case example, even though it had many potential pitfalls in terms of experimentation.

5.3.3 Case B: Innovation Challenge & Invention Disclosure

Description & Background

In April KONE Innovation Management organised again an Innovation Challenge (described in section 4.1). An external company X was presenting their manufacturing methods and capabilities, and based on that presentation the teams had to generate ideas in the Innovation Challenge. Our randomly selected team of five engineers from KONE came up with several different ideas that applied the company X's area of expertise. We were encouraged to build a quick and dirty prototype during the 1-hour brainstorming session, so that the end presentations would be more tangible with the prototypes.

This anonymous idea, called "B", was selected during the brainstorming session and we even managed to build an illustrating prototype from the idea. Our presentation was warmly welcomed and the audience encouraged us to make an invention disclosure for KONE Patenting Team from the idea, since it was considered so novel and fresh.

A few weeks later our team gathered together and started writing the invention disclosure which had clear and strict guidelines how to compose the application. None of us were familiar with the process, but we were all really excited about the chance to make something that could be patented and commercialised. Before the application was submitted, we had a meeting with a patent professional about the application and idea itself, so that all the aspects would be considered in the application. The application was submitted for KONE Patent Board and we eagerly started to wait for the decision. We did not submit the idea into Innovation Tool – it was neither recommended nor prohibited. However, what we did was that we told our colleagues informally about the idea so that we could get some feedback and other insights.

Scope

In this experiment the scope from the research point of view is to see how the Innovation Challenge and Invention Disclosure process support currently the experimental culture. Again, this case example is valuable because Innovation Challenges are currently involving many R&D employees and each Innovation Challenge produces a couple of promising ideas that should be researched thoroughly. Making an Invention Disclosure is also a big part the early innovation process. Should the idea be experimented before the application is submitted? Does the application require some details that are based on empirical facts? Once the application is handled, what happens? Does the Patent Board suggest the next steps for an idea?

Observations

The first positive observation came from the idea workshop – the teams were given a material toolbox for quick and dirty prototyping. The meaning of a simple prototype was encouraged by the facilitators and therefore the threshold to build a prototype was relatively low. The atmosphere in the final presentations was very positive and supportive. Like

mentioned, the idea “B” was considered so novel the audience suggested to make an Invention Disclosure about the idea. On the other hand, no one suggested to make a prototype or experiments to support the Invention Disclosure. This moment would have been fruitful to give hints for the team how to build a prototype and make rough experiments in the local facilities.
Likewise, there was no discussion during the Innovation Challenge that how the responsibility should be shared after the event. This was the first point where an idea was endangered, unless the team was highly motivated to continue with the idea.

Idea B pointed out the need of early experimentation when a team is trying to sell an idea inside the company. Patent Board received an application that was well describing the benefits of the idea, but none of the features were really put under experimentation. For that reason the Patent Board had to decline the Invention Disclosure because they had no evidence if the idea would be event partly feasible.

5.3.4 Case C: Simple Idea to Innovation Tool

Description & Background

The third practical experiment, called idea ”C”, was serendipitously invented during the second half of the thesis process. The “C” related to elevator accessories and it should have been relatively easy to implement if the demand for the product was verified. Making a prototype for a real-life use case experiment should not be too difficult – all the needed materials and equipment were supposed to be found from the factory or from the prototyping laboratory. This idea was not limited by the standards or codes of the industry and there were no features that would have been related to safety.

After the preliminary and informal coffee table discussions, the idea was submitted to Innovation Tool to see how it would be treated. A video and sketches were attached to the application to address the current problem that the idea was solving. The category owner (champion) was working in Finland as well and therefore communication was expected to be easy during the early stages of the idea validation and evaluation. In addition to the Innovation Tool, the idea was also posted to KONE Yammer group, where people were asked to share their thoughts about the best possible ways to implement an experiment about the idea. People were also given a chance to join the prototype building sessions in Hyvinkää. This kind of volunteer-based invitation was something that had not been tried earlier at KONE, and naturally it had to be experimented what it would bring.

Scope

The main aspects that this third experiment was exploring is the efficiency of KONE Innovation Tool and the ability to build a prototype together with the manufacturing and product specialists. In addition to that, the experiment in Yammer was trying to find out how the society reacts to an open invitation that asks to collaborate. In a best scenario either the post in Innovation Tool or in Yammer would attract strangers to join the development work.

Observations

The first observations came again from the moments when the idea was presented face to face to other colleagues. The comments were supportive and everyone were able to see the potential of the idea to become a commercial product in the near future. After that the idea description was written and posted to Innovation Tool. There the idea got one comment that was supportive as well, but no further comments or likes were received, although people were asked to join the prototype building sessions in Hyvinkää. Neither did the champion or owner react to the new idea in the innovation tool.

A few weeks after the idea was posted to the innovation tool, the category champion was informally met in a coffee room. He was not aware about the idea, thus his daily routines had kept him busy. However, he was happy to hear about the idea, but he did not specifically recommend to make any prototypes or experiments, but on the other hand he asked if an invention disclosure has been made about the idea. On his opinion, it was better to make an invention disclosure before going public with the idea inside the company–otherwise someone else could steal the idea and get the reward from the invention.

The next phase of the experiment was the post to KONE Yammer group, where people were asked to give their ideas and tell how they would build a prototype. The post in Yammer raised more activity than the initial post in the innovation tool.

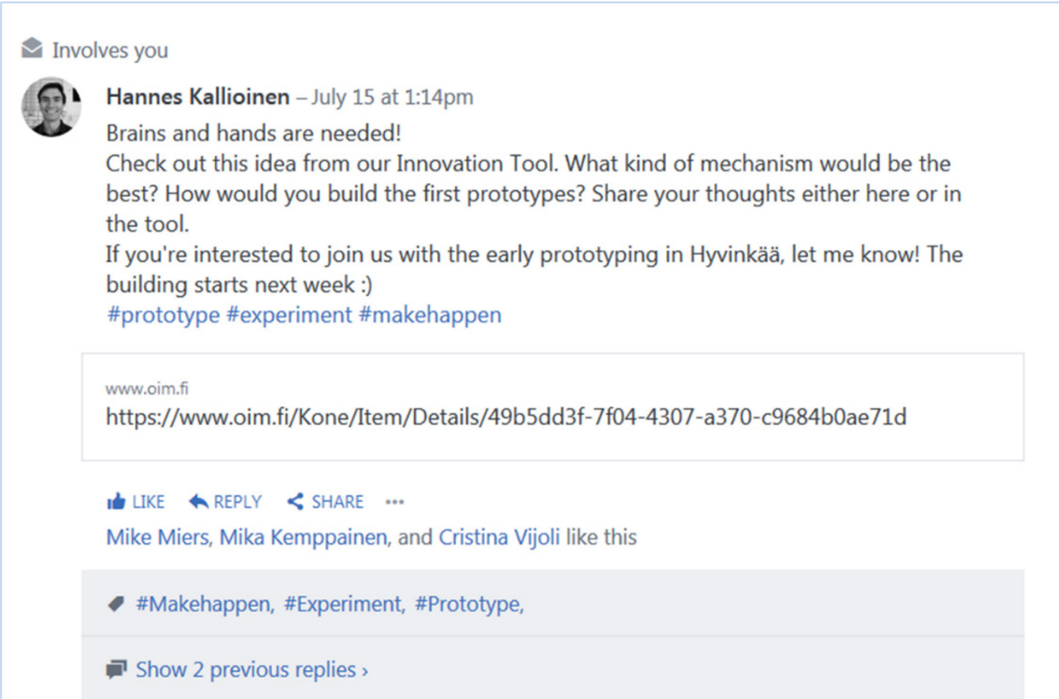


Figure 8 Original post in KONE R&D Yammer group

A few weeks after the Yammer post, the idea was taken to the workshop facilities. The target was to get a first prototype, either by making it alone or by getting help from someone. Again, the facilities were easy to access and the needed materials were found from a shelf. By a serendipity, a workshop specialist offered his expertise in making the prototype. 2D drawings were sent to him and the first prototypes were ready within one week.
At the same time an enquiry was sent to a test tower director, for the prototypes needed to be tested in a real environment. Unfortunately, this person was on a summer vacation, so the development paused for a few weeks.

Like in the Case A, the idea development will continue after the thesis is finished.

6

Results

However beautiful the strategy, you should occasionally look at the results.

–Winston Churchill

6 Results

The focus of the case study was to find out if the current arrangements are supporting experimental culture and how the practices could be possibly improved. The field experiments were done parallel to the general research and writing work of the thesis, and the development work will continue also after the thesis is finished. The survey was designed and distributed in May and the results were analysed in August.

6.1 Survey

This section summarises the overall findings from the survey that was sent to 240 KONE employees who had an approved idea in the innovation tool. In total 59 responses were received, covering all the five units. The sample became big enough to give an overview about the status of innovation and experimentation practicalities at KONE, however, any reliable comparison between different units could be made, since all the units were not equally represented in terms of respondents. The explicit survey data with visualisations can be found from Appendix 1.

6.1.1 General Findings

Respondent's Background

Questions 1-4

The survey started with a simple background data collection. Unit-wise, the responses distributed as follows: China 4, Finland 18, India 19, Italy 5, North America 5, and Other/Anonymous 8, and over half of the respondents had worked at KONE more than eight years. Only 1/4 of the respondents had had an introduction to innovation process and practicalities when they had started at KONE. On the other hand, 2/3 of the respondents said that they have participated at some point into an Innovation Challenge. More than half reported to know how to make an invention disclosure and half had actually made one or several invention disclosures.

Respondent's Idea

Questions 5-7

Next, the survey asked how the respondent felt about the processing of the idea. One third were not satisfied how quickly the idea was processed and approved, and more than half of the respondents thought that the instructions were not clear how to continue with the idea. Similarly, more half reported that no one had suggested them to make experiments about the idea. Next, managerial aspects were asked – in total 10 people said that management does not seem to be interested about their idea. Likewise, approximately 10 people said that they do not know who is the Champion and Owner of their idea. These three findings together leave inevitably room for improvement in the near future.

Subsequently people were asked if they had made any experiments, prototypes or mock-ups before the idea was submitted to innovation tool. More than half said that they had just submitted the idea, whereas one fourth had made some kind of experimenting with the idea, and 10 people said that they were planning to make an experiment, but that never happened.

Progress of the Idea

Questions 8-12

The following question was mapping if there had been any progress after the idea became approved. Here the results were surprisingly even – Yes: 29 answers, No: 30 answers.

Depending on the answer, the respondents were guided to tell more about the progress or about the reasons that caused the idea to stop.
One third of the *Yes* group informed that they had made real prototypes or experiments and having discussions with champions and owners. Only five out of 29 reported that they had contacted external parties or suppliers, which can be considered as a relatively low value.
Half of the progressed ideas were reported being under development at the moment and one third were fully implemented. Interestingly, the development responsibility was handed out for someone else in the case of eight ideas.
The next phase was to hear about the ideas that had not moved forward after the approval. Here up to 13 out of 30 stated that the unclear instructions how to continue had caused the idea development to seize. Lack of time, difficulty of global collaboration and insufficient incentives were also mentioned as remarkable reasons for the seized idea development. Positively, only one respondent thought that lack of money had caused the idea to stop.
Lastly, it was asked from these people behind seized ideas if they still feel that the idea would be worth to take forward. Surprisingly up to 25 out of 30 thought that the idea is still valid and should be developed, which needs to be considered as a positive sign in the context.

Awareness and Views about KONE Innovation Process
Questions 13-16
Question number 13 was a warm-up question for the general views about KONE innovation processes. The question was asking which grade (1-10) the people would give for success of ideation and actual implementation. A bit surprisingly, the ideation grade was lower than expected (6.12) and on the other hand the implementation grade was relatively close (4.93) to the ideation grade.
The following five questions were true or false claims, where people's general knowledge was tested. Almost every claim produced worrying findings – first, over half did not now that approved ideas will have budget for development. Secondly, one third of the people thought that no experiments are allowed to make before the idea is approved. The third claim pointed out that there are several people who don't know the difference between approved idea and Blue Project. Fourth, more than one third did not know that every idea has a champion and owner. This finding relates to question 5, where also one third reported that they do not know how the champion or owner of their idea is. Lastly, the remaining claim pointed out that KONE innovation themes are poorly known, and should be more promoted.
Question 15 was an open field question where people were asked to tell how the ideas-to-solutions success rate could be improved. These are the selected highlights from among 27 responses:

"Once an idea is placed into the innovation tool there is no visibility of what happens after submission. The process isn't clear and the involvement of the idea creator is minimal to non-existent. --"
"More of these "quick and dirty" checks for ideas without large effort on planning to get the development going, and to see whether the idea is worth anything. Prototypes are also important for connecting different shareholders and share ideas. --"

"--Locally there should be a person to proper follow up the process not as an "extra" task done in their "free" time, but something that should be part of their daily priorities to make it part of the unit culture and everyday topic. --"

"Problem is that Innotool is not part of anybodys daily work. It is only another annoying extra task. Decisions of further development are made alone. Answers to comments take ages. Of course really good ideas are taken into discussions at once. As a Champion I have no idea what happens after my comments. And I think idea maker does not know even as much. -- Could we make InnoFace discussion forum that would be easy to access. --"

"--Promotion is needed, target and follow-up is needed. In this case there should be cost center specific follow-up of how people HELP to improve ideas in innovation tool. Currently it shows that some people being forced to act as champions/owners, are not trying to really help, instead you get the feeling that they are more trying to discourage ideas. --"

"Local innovation manager should take responsibility to drive the ideas and, support to push champion and Owner to comments. --"

"--there could be a follow up of the most promising ideas with owners e.g. every 3 months. This could help to push people in going ahead and to monitor that ideas are not in the LIMBO after the approval phase. -- "

"Create a sort of Idea Factory, a facility where to test and experiment if idea works"

"Prototyping support as a sandbox environment, KONE engineers have dedicated paid hours to support the prototyping. -- "

"more communication; encourage active experiementation"

Next after the open comments, the question 16 proposed 7 claims and 4 arguments about KONE innovation process.

- 25/59 agreed that it gives enough of freedom for the implementation.
- Only 14/59 though that champions and owners are useful for the ideator.
- 15/59 were satisfied with the available expertise & professionals for the idea implementation.
- 24/59 thought that the process supports to take risks.
- 25/59 saw innovation tool as an effective way to push ideas forward
- 32/59 had a good understanding about the different stages of the innovation process
- Only 10/59 agreed that learning experiences are shared among R&D people
- Up to 16/59 agreed that proper planning can replace experimenting
- 52/59 disagreed that making experiments is waste of recourses
- 54/59 agreed that experiments generate learning
- 41/59 though that having an Experimentation Master in each unit sounds like a good idea

Bottle necks & Accessibility

Questions 17-20

The following four questions were mapping the possible bottle necks of experimentation and idea development. In addition, the awareness about the available workshops was examined.

Question 17 proposed nine different bottle necks of experimentation. Here, the main findings were:

- The importance of experiments is not emphasized well enough
- Too much of time is used to planning, instead of actual experimentation
- Failures are highly accepted as part of the process
- Managers should give more support to make experiments
- R&D people are capable to recognise a situation where experiments would be useful
- Getting help for experimentation is not too easy
- The process is considered too slow and it is hindering experimentation
- R&D people see that they have the needed skills for experimentation
- The question about who should make the experiment is dividing opinions

Next, the question 18 was asking why a promising idea or concept eventually dies. Here, the respondents were able to select multiple causes, and the six main reasons were:

- Lack of time
- The idea gets stuck in the innovation process
- Lack of human recourses
- The idea is not exposed to experiments and testing
- It is unclear how to proceed with the idea
- Idea steering is poor

Lastly, before the open comments, the questions 19 and 20 were examining if the respondents are aware about the workshop facilities and if they are also able to access them. Here, the finding was:

- Half of the people report having a place where make prototypes or experiments, and these people were also able to access the facilities
- One fourth report having no facilities
- One fourth does not know if they have facilities for making prototypes or experiments

Open Comments

Question 21

These are the selected highlights from among 20 responses:

"We should encourage testing more!"

"We need more rapid prototyping, failing fast. When we build a prototype we actually build the complete solution and try to validate a lot of concepts in one shot; that increases the probability of failure in that big prototype. We can build a lot of rapid prototypes before, using cheap and easy to get materials, just to quickly test the main concepts of the idea. After that rapid prototyping process is done, is almost sure that the complete solution prototype will work."

"If there is an existing Innovation process, I would say it is not well communicated within all the units. --"

"It would require time to make experiments. If you're involved in daily business activities then it' almost impossible to find time for experimenting other ideas than directly related to your current activities. --"

"In my Unit people should understand better that Innovation is our work. Too many time I hear " I have no time for that". -- "

" -- Slight reward system for prototypes that can work (demonstrated with elevator or with process) should be definitely looked into, so people would be encouraged to push forward their ideas for further evaluation by others."

"it would be great help if there is a separate facility for experiments."

Summarising the Findings from the Survey
The innovation governance has room for improvement – several ideas had seized because the instructions and support were missing or the slow process just supressed the idea. Respondents were claiming that the champions and owners could handle their job better, and many responses pointed out that both the innovation process and the innovation managers are poorly known.

The importance of experimentation is not emphasized enough. Instead of making experiments, too much of time is just used for general planning. In general, respondents report having the needed skills to make prototypes or experiments, but getting help for the implementation part is currently not too easy. Experimentation facilities are partly limited and poorly known – only half of the respondents reported to have facilities that they can also access.

Monetary aspects do not seem to hinder the idea developments. However, not all the respondent knew that approved ideas will always have budget for experimenting the idea.
The usefulness of experiments was not disbelieved. Nonetheless, people felt that they don't have either enough of time or expertise to implement proper experiments, so there would be an urgent need for helping hand.

6.1.2 Statistical Highlights from the Survey

The statistical analysis was able to offer some noteworthy findings, though the size of the sample was limiting to get any scientifically reliable results. Especially the most specific, and thus small, question combinations might have a strong sampling effect and cause artefacts that need to be carefully considered. The most interesting finding can be found between figures 10 and 11 which illustrate the difference between the employees who have managed to implement their idea or not. Another finding, though not surprising, is that employees who have access to the prototyping space are more likely to make experiments (Table 5).

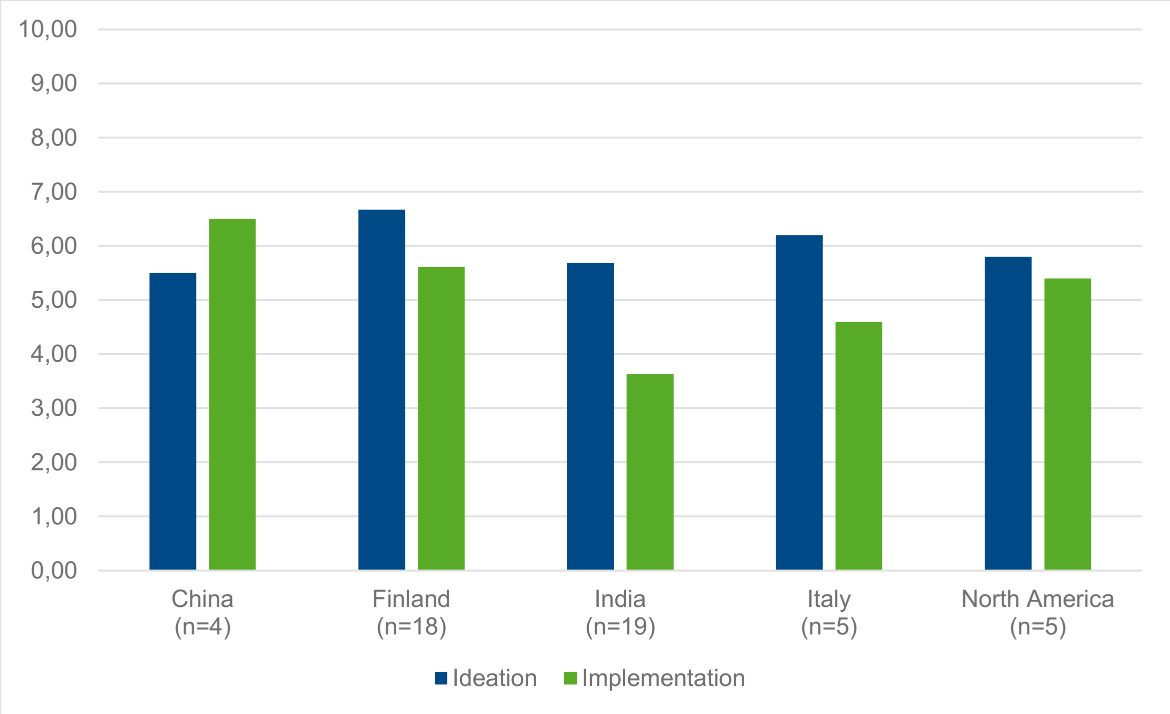


Figure 9 The question 13 asked to tell how well the respondent's unit is performing in the ideation and implementation part. A significant difference can be found between the results of Finland and India.

Table 3 If the idea presenter concerned that the idea was processed quickly, he/she was more likely satisfied with the given instructions. A cross tabulation inside the question 5.

		My approved idea at KONE Innovation Tool: *I received clear instructions how the idea can reach the next milestone*
My approved idea at KONE Innovation Tool: *The idea was processed and approved relatively quickly*	Pearson Correlation	,481**
	N	59

Table 4 Cross tabulation between questions 3 and 9: Employees who have participated into an Innovation Challenge are more likely to make experiments than those who have not participated into the event.

			Yes - What kind of progress? Making a real prototype or experiment (can be e.g. a simulation as well)	
			No	*Yes*
Induction, Training and Innovation Challenges: I have participated into an Innovation Challenge	*No*	Count	8	3
		% within	72,7%	27,3%
	Yes	Count	10	8
		% within	55,6%	44,4%
Total		Count	18	11
		% within	62,1%	37,9%

Table 5 Cross tabulation between questions 7 and 20: If an employee has access to the prototyping facilities, he/she is more likely to make experiments.

		I have easy access to these facilities		
		Yes	*No*	*I don't know*
Did you make some experiments, mock-ups or prototypes before the idea was submitted to Innovation Tool?	*Yes*	10	2	2
	No, but I was planning to do a prototype or an experiment	3	4	3
	No, I just submitted the idea	15	9	6
	Total	28	15	11

Table 6 Cross tabulation between questions 5 and 11. Knowing the champion does not mean that the employee would get clear instructions how to proceed with the idea.

		What reasons have stopped the idea development?
		Unclear instructions how to continue
My approved idea at KONE Innovation Tool: *I know who is the Champion of my idea*	*Strongly Agree*	1
	Agree	6
	Neutral	0
	Disagree	3
	Strongly Disagree	2
	I do not know	1
Total		13

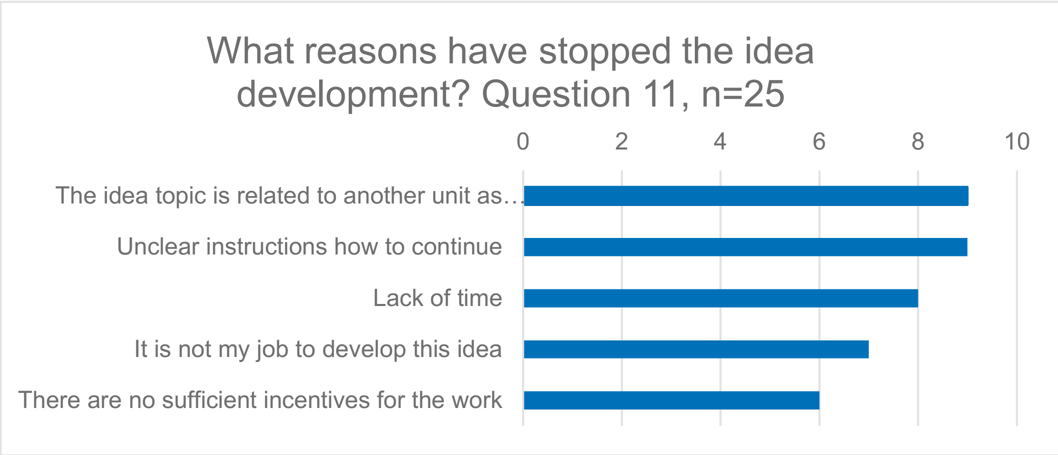


Figure 10 Group: Respondents whose idea has stopped after the approval (question 8), and the respondent thinks that the idea is still promising (question 12)

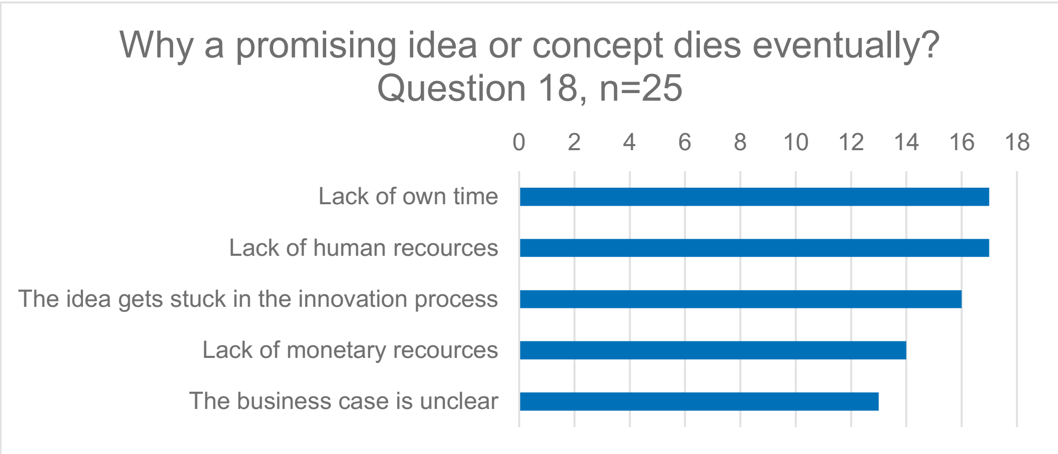


Figure 12 Group: Respondents whose idea has stopped after the approval (question 8), and the respondent thinks that the idea is still promising (question 12)

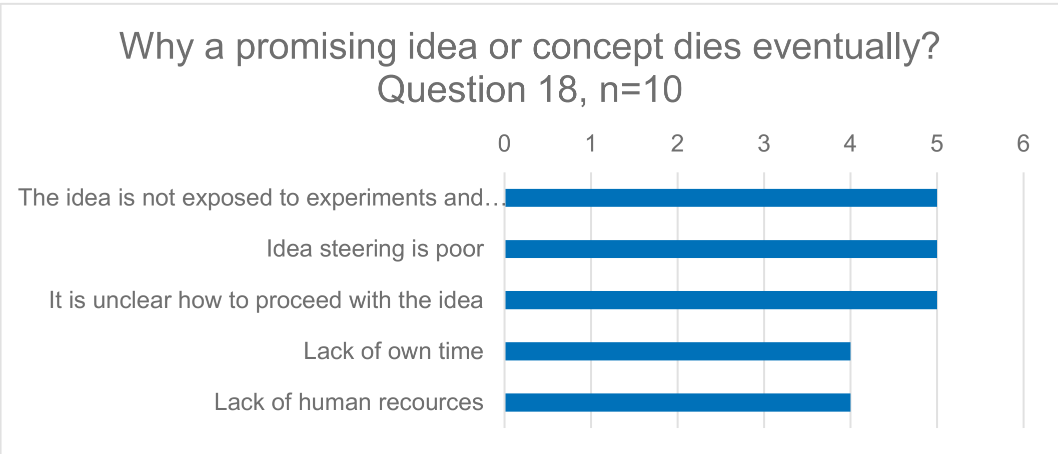


Figure 11 Group: Respondents whose idea has been fully implemented (question 10)

6.2 The Field Experiments: Key Findings

The field experiments offered a qualitative research about the ease of experimentation in KONE's premises in Finland. Together, the three experiments covered all the seven hypotheses from different angles.

6.2.1 Case A: Radical Single Idea

The Case A was examining how the practices and general opinions support the development of a radical idea. The experiment illustrated that the business case of this idea was understood and therefore the monetary aspects were not hindering experimentation, and neither did the general opinions of individual people hinder the development. However, already this case showed that the idea development in early FEI requires proactive attitude from the ideator, since no one is keeping an eye if the ideas progress before they become real projects.

Another general finding was that all the KONE employees that were involved to the experiment were open-minded, helpful and even a bit curious. Often the discussions were also initiatives for general discussion about innovation and idea development, which made the people to start thinking in a creative way. It seemed that somebody just needs to spark the creativity.

What comes to the experimentation of the idea itself, the process showed on a practical level how difficult the experimentation is and on the other hand it showed it strengths. Going to the laboratory required effort and determines, but once the experimentation started, it yielded tons of new ideas how the product should be improved for the next round. Moreover, the experiments generated learning and discoveries which would have been virtually impossible to achieve in the office.

From the global point of view the Case A was an instructive example how difficult the idea development can be when there are no professionals close by. In practice the idea A would have belonged to the R&D in China, but on the other hand the preliminary results were better to get before sharing the idea for them. Also, the idea involved many questions that would have needed collaboration with building owners and facility managers. The crux was that the idea was too raw to be presented for external partners, and therefore the preliminary results were difficult to estimate.

As a conclusion, the Case A proved that experimentation is both possible and supported at KONE, but it requires active attitude and own trust from the idea owner. Unfortunately, in the given timeframe, the idea did not have enough of time to reach the first real decisions by champions and owners, but the near future will show how the idea is treated in the innovation process.

6.2.2 Case B: Innovation Challenge & Invention Disclosure

The Case B was focusing on all the hypotheses, except the H4. The first positive finding that supports experimentation came from the Innovation Challenge event, where the teams were encouraged to build a prototype about their ideas. Also, the example pieces that the company X had brought with them to the Innovation Challenge were useful and tangible in the idea development process. The atmosphere in the event was supporting creative thinking, but on the other hand teams were not guided how they should proceed with their ideas after the event. The teams were only recommended to submit the invention disclosure at some point.

Compiling the invention disclosure was a new process for the whole team in the Case B. The document template was filled in according to the instructions, but no experiments were executed, as they were not demanded in the application. A month after the submission the team received a negative decision from the patent board, which was naturally disappointing. However, this incident lead to a finding about current processes: What happened was a situation where the patent board received an uncompleted idea to be judged. In other words, the process was no ensuring that the idea has some kind of proof of concept or results from experiment before it is sent to patent board. Also, the team members recall, that the application did not recommend to make any experiments, and therefore the negative decision was understandable. Team members also commented that making experiments would have been presumably fun and meaningful, and the results would have helped the application to succeed.

The key finding from the combination of an Innovation Challenge and invention disclosure is that innovation management and patent board could easily improve the quality of the ideas and invention disclosures by gently steering the ideas before any applications are sent. This procedure would decrease the amount of inadequate applications and on the other hand the ideas would be improved during the first experimentation and prototyping sessions. Another finding from Case B is that currently the patent board does not suggest further steps for those ideas which are not concerned as patent worthy. Not all the ideas are worth to patent, but it does not mean that they would not have any business value for the company.

6.2.3 Case C: Simple Idea to Innovation Tool

Lastly, the Case C provided answers to hypotheses 4, 5 and 6. The first finding came from the Innovation Tool where the level of activity remained lower than expected. The idea was commented only twice even though the problem and solution were easy to understand. The second post to KONE Yammer group demonstrated that social media is a better way to reach employees than the Innovation Tool. Likewise, the post in Yammer made some employees to realise that actually KONE has an Innovation Tool, and that they need to request for an access for it. Nonetheless, eventually the Yammer post did not attract any employee to join the idea development which was the original scope of the experiment.

Parallel to the activity in the online tools, the prototype development took place in the workshop and test tower facilities. This process provided two findings. First, finding the right people from the workshop was not too easy. The workshop was not designed for a newcomer, as there were no clear instructions about the available staff or ways of working. However, the second finding was positive and supported experimentation: Once the right people were reached it was easy to get help for making the prototype. Moreover, booking an elevator for the experiment was easy and the intentions of the newcomer were not questioned.

To conclude the Case C, it seems that in this example supports the findings from the survey: Champions and Owners could react faster to the new ideas in the Innovation Tool, and on the other hand the available resources and facilities are supporting experimentation, but the necessary information should be easier to find.

6.3 Correlation with Hypotheses

In the beginning of the process, all the hypotheses were designed to be covered by the survey and three field experiments. However, it turned out that some of the hypotheses were difficult to examine, and moreover, depending on the interpretation, some of the findings counter together with respect to the original hypotheses.

H1 *The usefulness and effectiveness of experiments is known at KONE, but no one is putting pressure to really make experiments about an idea*

->True

Both the survey and Case B pointed out that employees are aware about the effectiveness of experimentation, but the actual implementation rarely happens, unless the ideator is proactive. Champions, Owners, Patent Board and Innovation Management should encourage employees to make more experiments.

H2 *The business case of experiments is not adequately understood at KONE*

->True and False

It turned out that getting money for experiments is rarely hindering experimentation at KONE, but on the contrary employees do not totally understand how big savings the early experimentation can offer.

H3 *Experiments are often seen as mechanical tasks, although the variety and nature of different experiment methods is growing*

->True

In the Case B nobody of the team members thought about making a computer simulation about the idea. Moreover, all the informal discussions during the research process support this hypothesis: the common mind set in R&D is that most of the solutions are mechanical and they are designed through a mechanical process.

H4 *The facilities and available resources are premium at KONE, but known poorly*

->True

Especially the survey pointed out that employees do not know what kind of facilities they have and in which way these facilities can be accessed. However, the field experiments demonstrated that actually the recourses are premium, once the right people are workshops are found.

H5 *There is too much planning, at the expense of actual doing*

->True, False and Not Applicable

This hypothesis turned out to be difficult to validate. The survey and Case B support the hypothesis, but on the contrary the Case A and also partly the Case C proved the hypothesis incorrect. However, it seems that at least some employees think that currently the organisation focuses too much on planning, instead of actual doing.

H6 *The bottle necks of experimentation are not caused by resources – the major barriers are either imaginary or come from insufficient steering in the innovation practices*

->True

All the case study methods support the hypothesis: Employees either think that they are not allowed to spend time on experimentation or then they underestimate their skills. In addition to this, the managers and the process in general are not demanding to include experimentation to the development proves.

H7 *The nature of the business is hindering the culture of experimentation*

->Not Applicable

This hypothesis was difficult to examine. Initially the safety-oriented mind set at KONE was believed to hinder experimentation, but this argument proved to be difficult to interpret from the results.

Table 7 Illustration: Validity of the hypotheses

		Survey	Case A	Case B	Case C
True	H1	X		X	
False	H2	(X)	X	X	
N/A	H3			(X)	
	H4	X	X		X
	H5	X	X	X	X
	H6	X	X	X	X
	H7		X	(X)	

7

Discussion & Recommendations

Action is the foundational key to all success.

-Pablo Picasso

7 Discussion & Recommendations

This chapter concludes and discusses the overall findings from the research. First, the initial key questions and objectives of the research are reviewed. Second, the findings are mirrored to the key questions and objectives in section 7.1 on a general level. Third, based on the findings both from the literature and case study, the section 7.2 presents a list of practical recommendations that aim to fulfil the main objective of the research: Strengthen the practices of experiment-driven innovation. Last, the section 7.3 discusses the validity and reliability of the results.

To begin with, these are the initial key questions that were set for the research:

- *Why Experiment-Driven Innovation would make a step towards preferred?*
- *How to integrate Experiment-Driven Innovation into the existing innovation process?*
- *How to communicate a common guidance about the updated innovation process and its flow for all the R&D people?*

Second, the initial goal was to apply the possible findings to KONE innovation practices, and therefore the following research objectives were designed:

- *Find and understand the strengths and weaknesses of current arrangements*
- *To make KONE R&D society more aware about the innovation process and its focus points*
- *Based on the findings, suggest recommendations for short term and long term implementation*

7.1 Findings and Implications

The overall finding from the literature is that experimentation is an effective way to improve the performance of NPD, in terms of time, money and innovativeness of the solution. Many companies do not understand the means and ends of experimentation. For a beginner, there are many pitfalls in the process of planning and running experiments, and therefore many organisations eventually avoid experimentation. However, by following a guiding process that is adapted from a scientific method, the experimentation becomes a research method that is logical and straight-forward. The best impact in experimentation is achieved by implementing an experiment as early as possible and by focusing on learning, instead of explicit results. Inevitably, in the case of KONE, the experimental approach would improve the effectiveness of FEI and push the process towards preferred state where quality and quantity of innovations is better than currently.

Similarly to the literature, part of findings from the case study support the suggestion that there should be more experimental culture in FEI. In the survey, many KONE employees disclose their awareness about the benefits of experimentation, but on the other hand they share their concern that there is too much planning at the expense of actual doing. Related to this, another finding is that either the innovation process or R&D managers are not encouraging or challenging employees to implement experiments. However, a positive finding from the structural point of view is that nothing seems to be hindering experimentation at KONE. This finding is important in terms of near future, as the goal is to strengthen the experimental practices at KONE. Presumably the implementation requires less effort as the employees and organisational practices currently not hindering experimental approach in NPD.

An important finding from the case study is the importance of communication. Currently it seems that the biggest obstacle in experimentation for a newcomer is the lack of available information. A vast amount of the know-how is leaning on quiet information, and therefore an unexperienced employee has difficulties to know about the available resources and general practicalities. To solve this problem, a few introduction videos for internal use were produced parallel to the research process. These videos were concerned as an inspiring and effective way to deliver essential information about KONE innovation process and its features. The production of the videos will continue in the near future and the videos will be embedded to a new intra website where the goal is to have all the necessary information in a user-friendly format. Moreover, the goal is to provide such a content which is both interesting and needful for any employee, irrespective to their experience. One major finding that the case study provided, is that most of the employees do not have the latest information about the current processes.

Overall, the case study points out some strengths and weaknesses of the current arrangements. The most essential strength at the moment seems to be that nothing hinders experimental methods and in addition to this, the level of willingness to make a change is high. In this context, the clear weakness is that so far the governance has been low and therefore the practical implementation has not been put into action. However, the needed changes are moderate and do not require big investments or organisational changes.

Lastly, the research produced an auxiliary finding how experimentation could be divided into two main approaches. The following finding relates indirectly to the research questions and objectives, and on a practical level the suggestion can be applied to KONE innovation process, like the Figure 13 illustrates.
The literature does explain a lot about experimentation and its theories, but however, there is no available any clear or rough categorisation for the two fundamental approaches that are present in experimentation on a practical level. Based on material that was read, discussions and on personal experiences, this research suggests that a type of an experiment is always either *Goal-Oriented* or "*What If?"* -oriented.
In the first type, the team has a clear goal which they are trying to reach by making various experiments. Goal-oriented experiments are often parallel and in each of them one variable is being manipulated. Describing examples of the goal-oriented approaches are for example Thomas Edison and his light bulb development project or pharmaceutical science in general. In both examples the goal is known, but the composition is unclear and needs to be discovered by experiments.
In turn, the *what if* approach is the one people use when they are curious to see what the consequences of an action are. Like mentioned earlier, a child throwing a glass of milk is a simple example of *what if* experiment can mean. Similarly, a describing example from the business world is the case where a Finnish grocery decided to try how the customers would react if they established a slow cashier into a supermarket (Hassi, Paju et al. 2015). In most of the *what if* approaches there is also some kind of a goal on the background, but the path is often very unclear. Therefore, the radical and individual experiments are helpful to make rough iteration in the beginning of the process.

Based on this finding, the suggestion for KONE for it's that the experimental approach should be consciously selected, depending on the maturity of the idea.

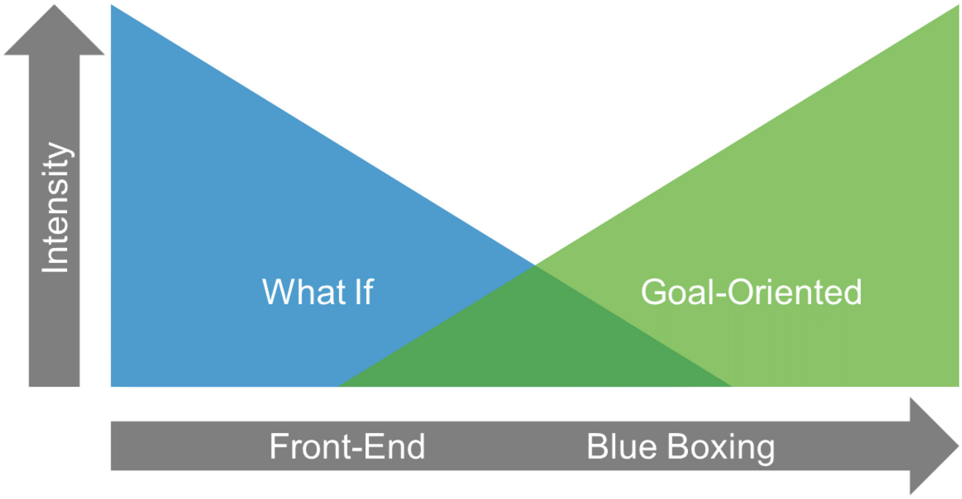


Figure 13 Suggestion on a general level when to use What If and Goal-Oriented approach in KONE innovation process

7.2 Practical Recommendations

The following recommendations are based on 1) general observations during the research process at KONE 2) findings from the survey 3) field experiments in KONE Finland. Each recommendation is aiming to make the practices at KONE to support the experimental culture, and therefore make the innovation process more efficient and reliable in general. The first part of the recommendations focuses on such actions that could be implemented quickly without any big development projects. The latter part of recommendations is for the near future's implementation. To fulfil these recommendations, it may require either time, money or managerial decisions in the company.

7.2.1 Recommendations for Immediate Use

New employee induction

The long-term effect of new employee orientation is often undervalued. It is a lot easier to tell for a new person about the facilities and ways of working, instead of trying to deliver the message for a case-hardened employee. In order to make the society more aware about the innovation practicalities and facilities, they need to be well introduced. A practical way to make sure that each area is covered in the orientation, is to make a physical hand-out with checkboxes, let's call that *Innovation Passport*. The passport will include such checkboxes as Innovation Tool test idea, visit to laboratory, Innovation Challenge participation, watching innovation video introduction, etc.
This passport could be also handed out for all the existing employees, just to kindle the curiosity about company's innovation opportunities.

Introducing Innovation Managers

KONE Innovation Managers are human link between the innovation strategy and practical work in every R&D unit. The role and purpose of innovation managers should be made more transparent, human and approachable, so that no one would hesitate to contact Innovation Manager in any matter. In practice this message could be delivered by posters where all the managers are with their photos and contact information. Also, every Innovation Manager could have a weekly open appointment time in a café.

Rapid Prototyping Space

Even though the survey pointed out that people are mostly aware about the workshop facilities, sometimes the physical distance is the biggest obstacle. The threshold to make a prototype or an experiment needs to be as low as possible. Therefore, each R&D unit should have an integrated and open rapid prototyping space in their office space, right there where the engineers are. This entry-level workshop would be supplied with some simple materials and tools, such as plywood, glue, jigsaw, wire, etc.

This space would also have the information billboards how the innovation process works and how more complicated models can be built in the real workshop.

Integrating experimentation into idea approval

An approved idea is the first step for an innovation. In the near future, the approval should contain the instructions how the idea can reach the next level. These instructions would tell what kind of experiment or prototype would be worth implementing.

Experimentation ABC booklet

Tangible information is sometimes the best. The suggestion is to design a paper booklet that has instructions how to make an experiment. The booklet would also have simple checkboxes for completed stages, just like in the new employee Innovation Passport.

Videos about innovation process and idea development

A good way to appetize information is to watch compact videos and learn from them. The purpose of the videos is to bring innovation practicalities and opportunities closer to every employee, so that they can identify themselves being part of the society. For example, the innovation process and idea development opportunities could be opened through two-minute videos with a few stories narrated by real personas.

Comprehensive Innovation Portal

Starting from the Innovation Tool itself, everything is currently difficult to find from KONE intranet. What needs to be done, is to merge all the information under one website – for example naming it *innovation.kone.com*

That site would offer all the necessary information such as:

- Key persons contact information
- Innovation Tool
- Innovation Process videos
- Patenting information
- How to access and work in workshops
- Experimentation ABC

Discussion Portal for Experimenters

One minor finding during the *Idea C* was that there is no discussion portal where experiment-minded people could share their thoughts and ideas. The suggestion is that each unit could have their own Yammer group where the community could tell about their projects and ask for help. The group could be called for example *Prototypers' Club.*

Experiments & Invention Disclosure process

The collaboration between Patent Board an Innovation Management should be enhanced. Currently, Patent Board received several invention disclosures that are just raw ideas without any evidence of actual feasibility.
Idea B became a great example how a promising idea should have put under experimentation before making any invention disclosures. In an ideal case the team would have made rough experiments with the assistance of Innovation Management, and then composed the application.
Now, what eventually happened was just a simple denial because Patent Board could not see if the idea would really work.
Here also, the decision cover letter from Patent Board should be formulated so, that it would tell more widely why idea invention disclosure was declined and what should be done next. By supporting the ideator to make experiments about the idea, and then returning back with a new application would yield better results – sometimes the first application comes just too early for Patent Board.

Include Experimentation to Innovation Toolbox

Currently there are some methods which are meant to boost innovation development in the FEI. The suggestion is to include experimentation as an Innovation Toolbox method to the list, and also introduce the new method through an instruction video.

Improved Workshop Information

Accessing the workshop was not intuitive and it was unclear what is allowed and what is prohibited. To lower the threshold of experimentation, the workshops should contain information billboards how to use the workshop and who to contact when something is needed. Also, all the employees do not have the access to workshop or they do not have required safety passes and therefore the workshop staff should be easier to find.

Closer Collaboration with Partners

Many of the sources in the literature emphasised the meaning of collaboration with external stakeholders, such as suppliers, universities, customers and end-users. An easy way to start the collaboration is to organise events like Innovation Challenge together with these stakeholders. Later, the ideas can be experimented together in order to ensure the benefits of collaboration.

Experimentation theme week

Organising a theme week in each unit is an effective way to emphasise the meaning and effectiveness of experimentation. In practice the theme week could include lectures, workshops and challenges which would demonstrate how anybody can apply experimental methods in their daily work. Another perspective of such an event is to bring people together and make them to share their thoughts.

7.2.2 Recommendations for Future Implementation

Experimentation Master

In addition to the Rapid Prototyping Space, each R&D unit should nominate or hire *Experimentation Master* who would be an evident link between the R&D people and workshops facilities. This persona would regularly go around the offices and coffee rooms, and ask if people would need help in illustrating their ideas. Also, the Experimentation Master would meet the ideators whose ideas become approved in the

Innovation Tool. The Experimentation Master would know how to use all the machinery and how to design a good experiment.

A good way to make experimental culture visible and sustainable would be to organise *Experimentation Week* once a year in each unit. The theme week would remind people to consider how they could utilise experiments in their current projects. Highlights of the week would be a weekend event, Myth Busters, where the employees could build and experiment the myths that people have sent over the year.
The week would also offer a chance to participate on a course that teaches how to experiment.

Making experiments part of strategy

The current innovation strategy does not mention that the experimental approach should be practiced in the new product development. Like discovered earlier, both the literature and empirical findings are addressing the impact of experiments in the NPD. Presumably KONE wants to follow this finding, and therefore the company's innovation strategy should deliver such a message that is seen important. Embedding to the strategy the suggestion to use experimental approach is highly important in the long term. On a practical level the top management should encourage the employees to be curious, make experiments and always focus on learning.

7.3 Validity and Reliability of the Results

The results from the case study need to be considered as approximate, yet guiding. This section is discussing how reliable and applicable these results should be seen.

First, the sample of the survey was not representing a neutral sample of the entire R&D. The recipients of the survey are employees that were already active in innovation as they have submitted an idea to the innovation tool. Second, the employees who eventually shared their thoughts in the survey are presumably representing even a more active share of the original recipients. In terms of different units, any reliable comparison was not possible to make, as the responses came mainly either from Finland or from India. However, the overall understanding was possible to draw from the 59 responses.

The latter part of the case study, the field experiments, offered qualitative but relatively narrow data about the ease of experimentation in Finland. These experiments gave valuable information, demonstrating that at least by proactive attitude nothing seems to be hindering experimentation.

The literature review and case studies included possibly some distortion and bias effect, as the research mainly focused on strengthening experiment-driven innovation, not seeking for alternative ways to improve FEI and NPD. For example Hüsig and Kohn (2003), Khurana and Rosenthal (1998) and Zhang and Doll (2001) do not highlight the importance of experiments even though they introduce several different ways to improve the FEI process.

The necessity of the practical recommendations should be also discussed. There are possibly some recommendations that are seen important because of the bias effect in the study. Related to this, it is also important to evaluate the ways in which the improvements will have the desired effect. Lastly, the research did not find explicit answer for the question that why an individual employee stops the experimentation. Furthermore, the incentives of experimentation were not examined in the research work. Likewise, the research work did not find any reliable answers how the experimental culture does occur in general.

8

Conclusion

No amount of experimentation can ever prove me right; a single experiment can prove me wrong.

-Albert Einstein

8 Conclusion

The research focused on discovering the ways in which experiments can affect FEI and NPD in general; based on these findings, the specific goal was to observe the support provided to experimental culture at KONE, and lastly, find ways to improve these practices.

The inevitable result from the literature review was that experiments offer an effective method in the pursuit of innovations. The earlier experiments are executed, the more effectively they impact the complete innovation process. Experiments cut development cost and time, improve product quality and generate unseen discoveries. Similarly, experiments reduce uncertainty and help to detect the incorrect development paths sufficiently early.
The most serious, and only, failure in experimentation is to leave an experiment undone. Implementing a successful experiment often requires expertise and moderate planning, and the results reflect the quality of the experiment. The primary goal in experimentation should always focus on learning, not just gaining explicit results. Initial hypotheses are often proven to be incorrect, but this is immaterial when the reasons behind the deviation are analysed and applied for further use.

Although no source recommends avoiding experiments, in reality, experiments do not always hold intrinsic value in research and development. Sometimes a day in the library can save a month in the laboratory.

The research questions and objectives that were designed in the beginning of the research work are covered for the most part. However, it should be recalled that the field experiments only offer a narrow view of the situation from within the constraints of KONE, Finland. Furthermore, the sample size of the survey is limited: the respondents represent a group of R&D employees that are in principle active in innovation. Nonetheless, the case study offers three main findings: First of all, it seems that KONE processes, organisation and R&D culture in general are compatible with an experimental approach: no element hinders experimentation, but simultaneously no one encourages or demands using an experimental approach in FEI. Secondly, from the communicational perspective, there is room for improvement in the awareness about the available resources and idea development opportunities. Moreover, KONE's updated innovation process requires larger promotion in the near future. Thirdly, the idea development and progression in FEI overly relies on the serendipity and proactive attitude of an inventor. Even though FEI is considered to be the innovation process phase with the most freedom and flexibility, nevertheless, a topic, such as experimentation requires some governance and support.

Consequently, some changes are required in order to strengthen the practices that support experiment-driven innovation, irrespective to the R&D unit. The actions for the near future implementation will naturally arise from the practical recommendations that this thesis suggests. The key elements in the improvement process are the quality of the distributed information and the possibility to tailor the required actions. Moreover, the next demanding task is to create change by implementing the suggestions and by informing the community about the updated innovation practicalities as well as kindle their curiosity towards an experimental approach.

References

Prototype. 2015. In: A.H. BLACKWELL and E. MANAR, eds, *UXL Encyclopedia of Science.* 3rd ed. edn. Farmington Hills, MI: UXL, .

3M COMPANY, 2002. *A Century of Innovation - The 3M Story.*

AHMED, P.K., 1998. Culture and climate for innovation. *European journal of innovation management,* **1**(1), pp. 30-43.

AMABILE, T.M., 1998. *How to kill creativity,* .

ANDRIOPOULOS, C., 2003. Six Paradoxes in Managing Creativity: An Embracing Act. *Long range planning,* **36**(4), pp. 375-388.

BERG, P., ELFVENGREN, K., KEVÄTSALO, J., PATANA, A., PIHLAJAMAA, J., PIHLAJAMAA, M., POSKELA, J., VALIAUGA, P., VANHARANTA, O. and VÄNSKÄ, J., 2014. Johdatus uutta liiketoimintaa luovien innovaatioiden maailmaan: Apuvälineitä innovaatiotoiminnan kehittämiseen.

BROWN, B., 2010. Why Innovation Matters. *Research Technology Management,* **53**(6), pp. 18-23.

CAMBRIDGE DICTIONARY, 2016a-last update, Experiment, Cambridge English Dictionary [Homepage of Cambridge University Press], [Online]. Available: http://dictionary.cambridge.org/dictionary/english/experiment [07/09, 2016].

CAMBRIDGE DICTIONARY, 2016b-last update, Mock-up, Cambridge English Dictionary [Homepage of Cambridge University Press], [Online]. Available: http://dictionary.cambridge.org/dictionary/english/mock-up [07/09, 2016].

CAMBRIDGE DICTIONARY, 2016c-last update, Pilot, Cambridge English Dictionary [Homepage of Cambridge University Press], [Online]. Available: http://dictionary.cambridge.org/dictionary/english/pilot [07/09, 2016].

CAMBRIDGE DICTIONARY, 2016d-last update, Prototyping, Cambridge English Dictionary [Homepage of Cambridge University Press], [Online]. Available: http://dictionary.cambridge.org/dictionary/english/prototyping [07/09, 2016].

CAMBRIDGE DICTIONARY, 2016e-last update, Test, Cambridge English Dictionary [Homepage of Cambridge University Press], [Online]. Available: http://dictionary.cambridge.org/dictionary/english/test [07/09, 2016].

CANNON, M.D. and EDMONDSON, A.C., 2005. Failing to Learn and Learning to Fail (Intelligently): How Great Organizations Put Failure to Work to Innovate and Improve. *Long range planning,* **38**(3), pp. 299-319.

COOPER, R.G. and KLEINSCHMIDT, E.J., 1994. Determinants of timeliness in product development. *Journal of Product Innovation Management,* **11**(5), pp. 381-396.

CRISCUOLO, C., HASKEL, J.E. and SLAUGHTER, M.J., 2010. Global engagement and the innovation activities of firms. *International Journal of Industrial Organization,* **28**(2), pp. 191-202.

EISENHARDT, K.M. and TABRIZI, B.N., 1995. Accelerating Adaptive Processes: Product Innovation in the Global Computer Industry. *Administrative Science Quarterly,* **40**(1), pp. 84-110.

FILIPCZAK, B., 1997. It Takes All Kinds: Creativity in the Work Force. *Training,* **34**(5), pp. 32.

GEARSHIFT GROUP, 2013. *Inno-barometer Report.* Gearshift Group.

GORDON, V.S. and BIEMAN, J.M., 1995. Rapid prototyping: lessons learned. *IEEE Software,* **12**(1), pp. 85.

GOVINDARAJAN, V. and TRIMBLE, C., 2010. *The other side of innovation: Solving the execution challenge.* Harvard Business Press.

GOVINDARAJAN, V., 2016. Planned Opportunism. *Harvard business review,* **94**(5), pp. 54-61.

HARDER, J. and TOWNSEND, D., 2011. WL Gore & Associates.

HASSI, L., PAJU, S. and MAILA, R., 2015. *Kehitä kokeillen : organisaation käsikirja.* Helsinki: Talentum Pro.

HUHTALA, H. and PARZEFALL, M., 2007. A Review of Employee Well-Being and Innovativeness: An Opportunity for a Mutual Benefit. *Creativity & Innovation Management,* **16**(3), pp. 299-306.

HÜSIG, S. and KOHN, S., 2003. Factors influencing the front end of the innovation process: A comprehensive review of selected empirical NPD and explorative FFE studies. *Proceedings of the 10th IPDMC,* , pp. 14.

KHURANA, A. and ROSENTHAL, S.R., 1998. Towards holistic "front ends" in new product development. *Journal of Product Innovation Management,* **15**(1), pp. 57-74.

KHURANA, A. and ROSENTHAL, S.R., 1997. Integrating the Fuzzy Front End of New Product Development. *Sloan management review,* **38**(2), pp. 103-120.

KIM, J. and WILEMON, D., 2002. Focusing the fuzzy front–end in new product development. *R&D Management,* **32**(4), pp. 269-279.

KONE CORPORATION, 17/09/2015, 2015a-last update, Changes in the Executive Board - KONE establishes a new Technology & Innovation unit [Homepage of KONE Corporation], [Online]. Available: http://www.kone.com/en/press/press/kone-corporation-changes-in-the-executive-board--kone-establishes-a-new-technology--innovation-unit-2015-09-17.aspx [04/12, 2016].

KONE CORPORATION, 21/08/2015, 2015b-last update, KONE in the top 50 of the Forbes' list of the World's Most Innovative Companies [Homepage of KONE Corporation], [Online]. Available: http://www.kone.com/en/press/press/kone-in-the-top-50-of-the-forbes-list-of-the-world-s-most-innovative-companies-2015-08-21.aspx [04/12, 2016].

MADSEN, P.M. and DESAI, V., 2010. Failing to Learn? the Effects of Failure and Success on Organizational Learning in the Global Orbital Launch Vehicle Industry. *Academy of Management Journal,* **53**(3), pp. 451-476.

MARTINS, E. and TERBLANCHE, F., 2003. Building organisational culture that stimulates creativity and innovation. *European journal of innovation management,* **6**(1), pp. 64-74.

MARTINSUO, M., 2009. Teaching the Fuzzy Front End of Innovation: Experimenting with Team Learning and Cross-Organizational Integration. *Creativity & Innovation Management,* **18**(3), pp. 147-159.

MATTHEWS, W.H., 1991. Kissing technological frogs: Managing technology as a strategic resource. *European Management Journal,* **9**(2), pp. 145-148.

MCNALLY, R.C., AKDENIZ, M.B. and CALANTONE, R.J., 2011. New product development processes and new product profitability: Exploring the mediating role of speed to market and product quality. *Journal of Product Innovation Management,* **28**(s1), pp. 63-77.

MEYER, B.D., 1995. Natural and quasi-experiments in economics. *Journal of business & economic statistics,* **13**(2), pp. 151-161.

MILLSAP, R.E. and MAYDEU-OLIVARES, A., 2009. *The SAGE handbook of quantitative methods in psychology.* Sage Publications.

NEWELL, A. and SIMON, H.A., 1972. *Human problem solving.* Prentice-Hall Englewood Cliffs, NJ.

NOBELIUS, D., 2004. Towards the sixth generation of R&D management. *International Journal of Project Management,* **22**(5), pp. 369-375.

ORTT, J.R. and VAN DER DUIN, PATRICK A, 2008. The evolution of innovation management towards contextual innovation. *European Journal of Innovation Management,* **11**(4), pp. 522-538.

PISANO, G.P., 2015. You Need an Innovation Strategy. *Harvard business review,* **93**(6), pp. 44-54.

SØRENSEN, F., MATTSSON, J. and SUNDBO, J., 2010. Experimental methods in innovation research. *Research Policy,* **39**(3), pp. 313-322.

TAN, G., 1998. Managing Creativity in Organizations: a Total System Approach. *Creativity & Innovation Management,* **7**(1), pp. 23.

TERWIESCH, C. and E. BOHN, R., 2001. Learning and process improvement during production ramp-up. *International Journal of Production Economics,* **70**(1), pp. 1-19.

THOMKE, S.H., 2003. *Experimentation matters: unlocking the potential of new technologies for innovation.* Harvard Business Press.

THOMKE, S. and BELL, D.E., 2001. Sequential testing in product development. *Management Science,* **47**(2), pp. 308-323.

THOMKE, S.H., 1998. Managing Experimentation in the Design of New Products. *Management Science,* **44**(6), pp. 743-762.

VON STAMM, B., 2003. *Managing innovation, design and creativity.* Chichester: Wiley.

WHEATLEY, M.J., 2002. We are all innovators. *Leading for Innovation, San Francisco, Jossey-Bass,* , pp. 11-22.

ZHANG, Q. and DOLL, W.J., 2001. The fuzzy front end and success of new product development: a causal model. *European Journal of Innovation Management,* **4**(2), pp. 95-112.

Appendices

Appendix 1: Initial Questions of the Survey

KONE

Mapping survey: Approved Ideas in KONE Innovation Tool

1. My unit *

- ○ CRD
- ○ FRD
- ○ IRD
- ○ RES
- ◉ URD
- ○ I prefer not to say
- ○ Other __________

2. Working years at KONE *

- ◉ <1
- ○ 1-3
- ○ 4-7
- ○ 8-15
- ○ >15

3. Induction, Training and *Innovation Challenges*

- ☐ When I started at KONE, Innovation Process & Practices were presented for me
- ☐ I have gone through the Innovation Tool e-learning material
- ☐ I have participated into an Innovation Challenge
- ☐ Other __________
- ☐ There should be more innovation workshops/trainings

4. Invention disclosures

- ☑ I know how to make an invention disclosure
- ☐ I have made an invention disclosure (one or several)

5. My approved idea at KONE Innovation Tool *

Please note: If you have several approved ideas, please choose only one of those while answering.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I do not know
The idea was processed and approved relatively relatively quickly	○	○	○	○	○	○
I received clear instructions how the idea can reach the next milestone	○	○	○	○	○	○
I was suggested to make prototypes or experiments about the idea	○	○	○	○	○	○
Management seems to be interested about my idea	○	○	○	○	○	○
I know who is the *Champion* of my idea	○	○	○	○	○	○
I know who is the *Owner* of my idea	○	○	○	○	○	○
I have tried to push my idea further	○	○	○	○	○	○
There are many unsolved questions in my idea	○	○	○	○	○	○

6. Type of my idea *

Classification in Innovation Tool
You can find your ideas from here: https://www.oim.fi/Kone/Item/List?p=My

Technologies

- ○ Hoisting mechanics
- ○ Doors
- ○ Cars
- ○ Machinery
- ○ Electrification and Drives
- ○ Software
- ○ Signalization
- ○ Remote monitoring
- ◉ People Flow Intelligence
- ○ High Rise Elevator Technology
- ○ Maintenance technology
- ○ Modernization
- ○ Escalators
- ○ Building doors
- ○ Elevator Platforms

Key Focus Areas

- ○ Customer experience
- ○ Eco efficiency
- ○ Ride comfort
- ○ Visual design
- ○ Quality
- ○ Safety Category

KONE Way Processes

- ○ Solution creation
- ○ Customer
- ○ Delivery
- ○ Installation
- ○ Maintenance
- ○ Documentation
- ○ *I do not know*

7. Did you make some experiments, mock-ups or prototypes before the idea was submitted to Innovation Tool? *

- ◉ Yes (you can shortly describe) ____________
- ○ No, but I was planning to do a prototype or an experiment
- ○ No, I just submitted the idea

8. Has there been any progress after your idea became approved? *

(in addition to general thinking, discussion and speculation)

- ◉ Yes
- ○ No

9. Yes - What kind of progress? *

Select one or more options that match with your idea

- ☐ Discussions with Champions&Owners or other category professionals whether the idea is feasible or not
- ☐ Patent Research
- ☑ Contacting suppliers or external parties
- ☐ Competitor benchmarking
- ☐ Paper/CAD sketches
- ☐ Making a real prototype or experiment (can be e.g. a simulation as well)

- [ ] Cost estimation or quoting
- [ ] Business value calculations
- [ ] Visiting a site which is related to the idea
- [ ] Visiting manufacturing facilities
- [ ] Other ____________

10. Backlog of the idea *

Select one or more options that match with your idea

- [x] The idea is fully implemented
- [ ] The idea is currently under development
- [ ] The idea development has not started after the approval
- [ ] The idea development has stopped, but may still continue
- [ ] The idea is archived
- [ ] Someone else is now responsible for the idea development
- [ ] The idea is (or was) a Blue Project
- [ ] The idea is (or was) a Red/Purple Project
- [ ] Other ____________

11. No - What reasons have stopped the idea development? *

Select one or more options that match with your experience

- [ ] Lack of time
- [ ] Lack of money
- [ ] Low support from Champion
- [ ] Low support from Owner
- [ ] Lack of available expertise
- [ ] Unclear instructions how to continue
- [ ] There are too many difficult questions to solve
- [ ] It is not my job to develop this idea
- [ ] This task has a low priority on my task list
- [ ] I doubt if the idea actually is feasible
- [ ] There are no sufficient incentives for the work
- [ ] The idea topic is related to another unit as well, and the global collaboration is difficult
- [ ] Other ____________

12. I still feel that the idea is promising and would be worth to take forward *

- ◯ Yes
- ◯ No

13. Innovation = Idea+Implementation *

It is said that this is the most simple equation for innovation. Please tell how your unit is performing in the argument.
1: Not well
10: Very well

	1	2	3	4	5	6	7	8	9	10
How well is your unit performing in the **ideation** part?	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
How well is your unit performing in the **implementation** part?	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

14. True or False? *

Be honest and don't take this too seriously :)

	True	False	I do not know
There is always budget available for the approved ideas	◯	◯	◯
An official approval is needed in order to start experimenting the idea	◯	◯	◯
An approved idea becomes right away a Blue Project	◯	◯	◯
Every idea has a Champion and an Owner	◯	◯	◯
KONE has defined 10 themes to drive innovation efforts	◯	◯	◯

15. Please give any ideas how the *ideas-to-solutions* success rate could be improved?

16. KONE Innovation Process *

Please tell how you feel about our current Innovation Process

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I do not know
It gives me freedom to implement an idea	◯	◯	◯	◯	◯	◯
Champions and Owners are useful for me in the process	◯	◯	◯	◯	◯	◯
It is providing me enough of expertise/professionals for the idea implementation	◯	◯	◯	◯	◯	◯

It encourages me to take risks						
I feel that *Innovation Tool* is effective to push my ideas forward						
I have an understanding about the different stages of of our Innovation Process						
Our learning experiences are currently shared among R&D people						
Arguments:						
Proper planning can replace experimenting						
Making experiments is waste of resources						
Experiments or prototypes generate learning						
There should be an *Experimentation Master* at each each KONE unit. (a person who helps to plan and make experiments)						

17. Bottlenecks of Experimentation *

Here are some general arguments about the reasons that are potentially hindering Experimentation and thus innovations.

	Strongly Agree	Agree	Neutral	Disagree	Strondly Disagree	I do not know
The importance of experiments is emphasised at KONE						
We are using too much time for planning and too little of time for experimentation						
Experiments might lead to a failure, but it is accepted as a part of the process						
My managers are supporting to make experiments						
It is easy to recognise if an experiment would be useful						
It is easy to get help for making a prototype or experiment						
Too slow process: The time from an idea to experimentation						
My own skills are good to make a prototype or experiment						
On my opinion, someone else should do the experiments on behalf of me						

18. Why a promising idea or concept dies eventually? *

Select one ore more options that match with your opinion

- [ ] It is thoroughly researched and tested - does not work
- [ ] The idea is ahead of its time
- [ ] It is unclear how to proceed with the idea
- [ ] Idea steering is poor
- [ ] The idea is not exposed to experiments and testing
- [ ] The idea gets stuck in the innovation process
- [ ] "Not Invented Here" - the motivation is low to push the idea forward
- [ ] Lack of human resources
- [ ] Lack of monetary resources
- [ ] Lack of own time
- [ ] Lack of development facilities/supplies
- [ ] Shared responsibility leads to a situation with no responsibility
- [ ] The business case is unclear
- [ ] Colleagues opinion kills my motivation
- [ ] Other:

19. We have a place in our unit where we can make prototypes or experiments? *

- ○ Yes (please answer to the next question as well)
- ○ No
- ○ I do not know

20. I have easy access to these facilities

- ○ Yes
- ○ No
- ○ I don't know

21. Open feedback: survey, innovation processes, or anything!

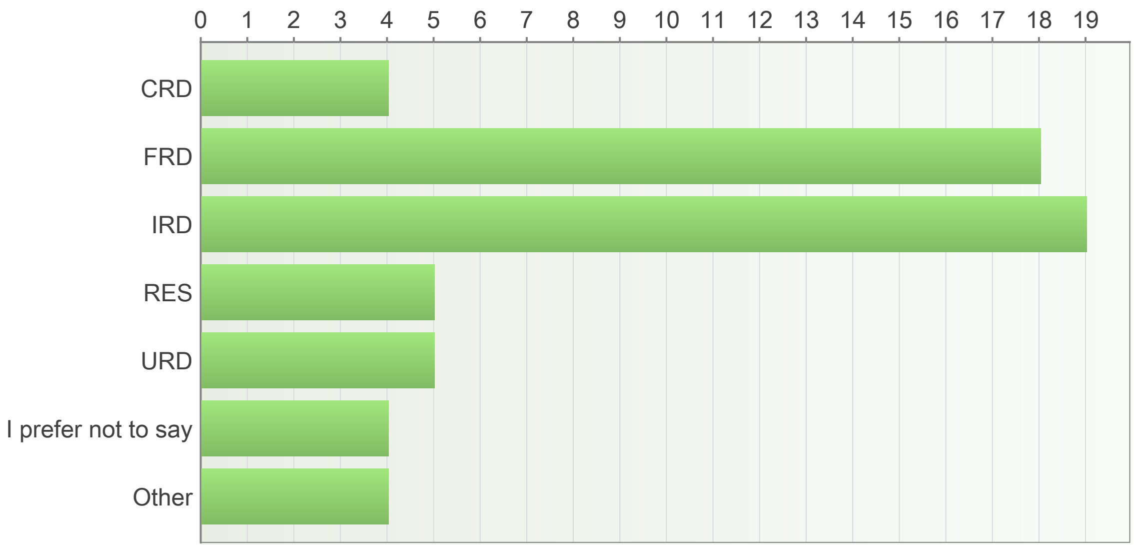
0% completed

Appendix 2: Summary of the Survey

Experimentation Survey

1. My unit

Number of respondents: 59

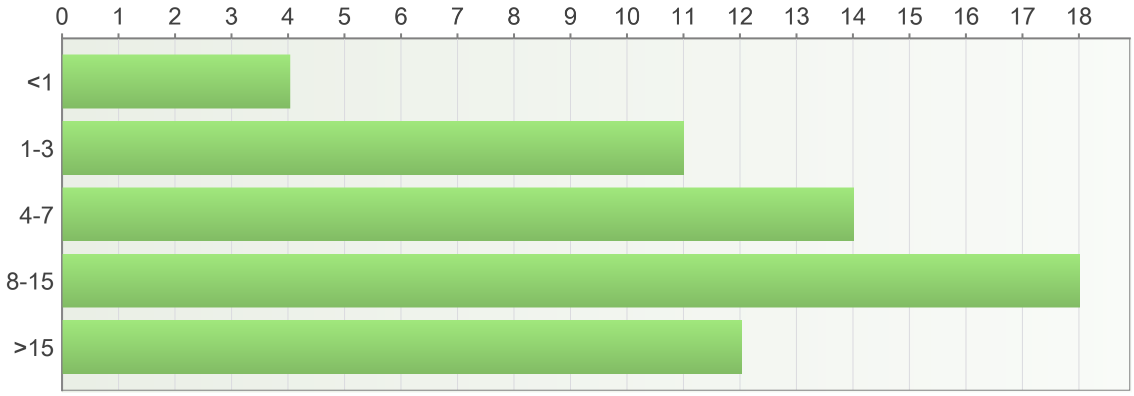


Open text answers: Other

- KTI - TCU
- ERD
- QRD
- Global Installaton

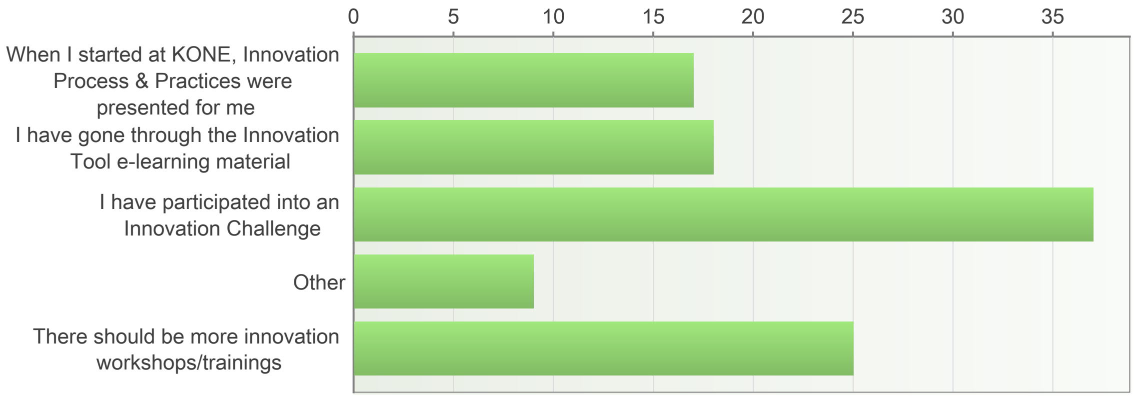
2. Working years at KONE

Number of respondents: 59



3. Induction, Training and Innovation Challenges

Number of respondents: 59

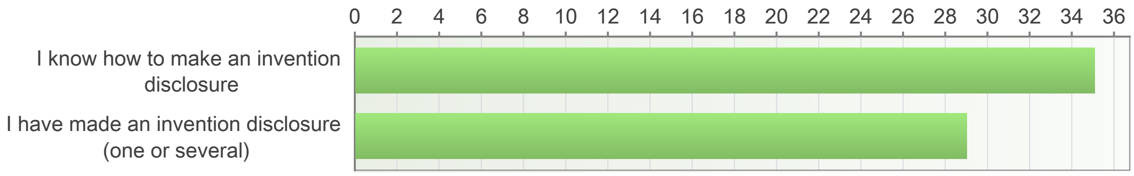


Open text answers: Other

- Innovation workshops
- colleagues
- I have learned innovation by myself
- When I started at KONE, I received my access for innovation Tool.
- Training on the job
- Found out be hearing from somebody
- I have participated as a facilitator even =)
- Used the tool

4. Invention disclosures

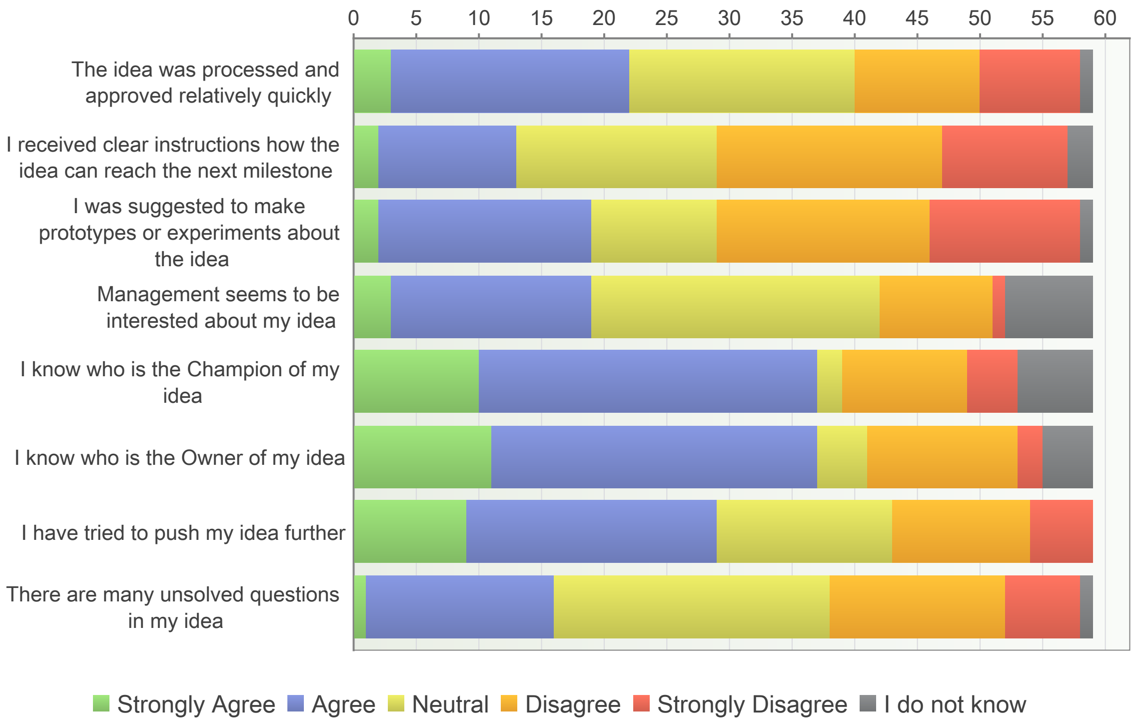
Number of respondents: 48



5. My approved idea at KONE Innovation Tool

Please note: If you have several approved ideas, please choose only one of those while answering.

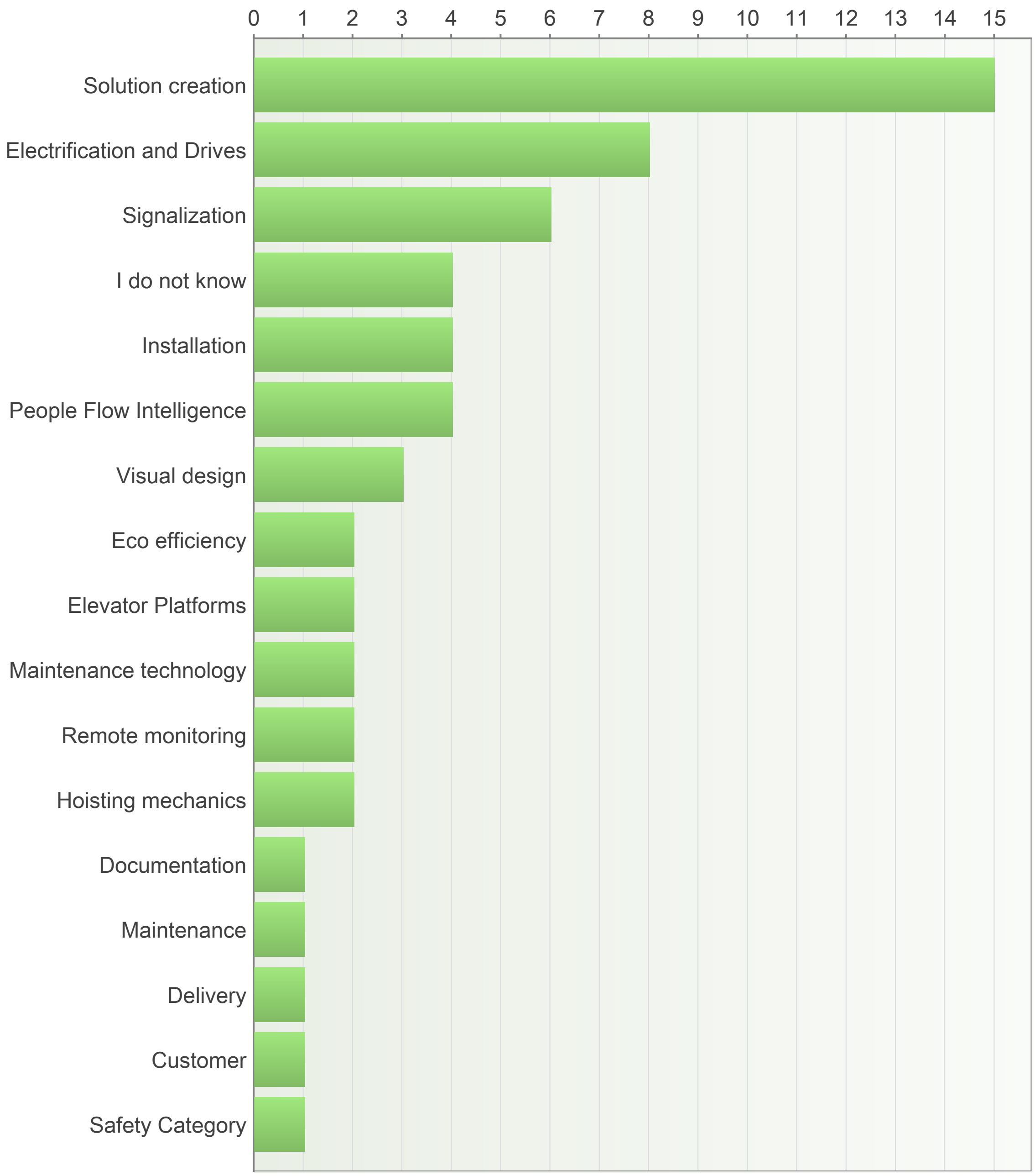
Number of respondents: 59



6. Type of my idea

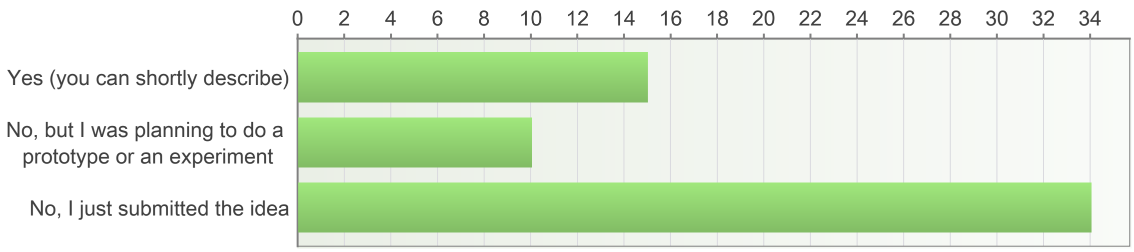
Classification in Innovation Tool You can find your ideas from here: https://www.oim.fi/Kone/Item/List?p=My

Number of respondents: 59



7. Did you make some experiments, mock-ups or prototypes before the idea was submitted to Innovation Tool?

Number of respondents: 59



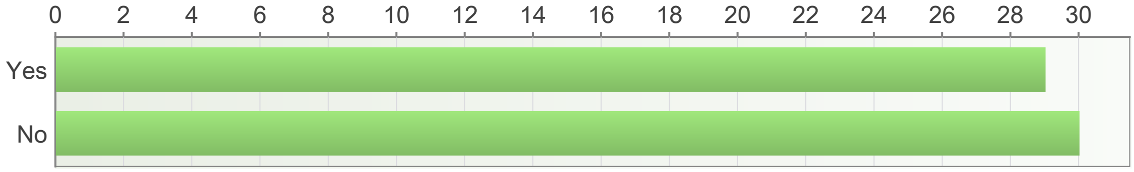
Open text answers: Yes (you can shortly describe)

- We did a "quick and dirty" prototype in working elevator
- rapid prototype for proofing the main concept of the idea.
- proof of principe: working demo
- Part of innovation workshop
- All ideas has been tested and most them is in use
- AMD door and GG door Voltage, current & Power measurement taken for CCB integrated drive
- Did not make any, but saw this solution in other crane industry branch
- Compensating chain twist remover , Gudie rail alignment tool , Sill gap fixer
- mockup
- Working proof of mechanical concept

8. Has there been any progress after your idea became approved?

(in addition to general thinking, discussion and speculation)

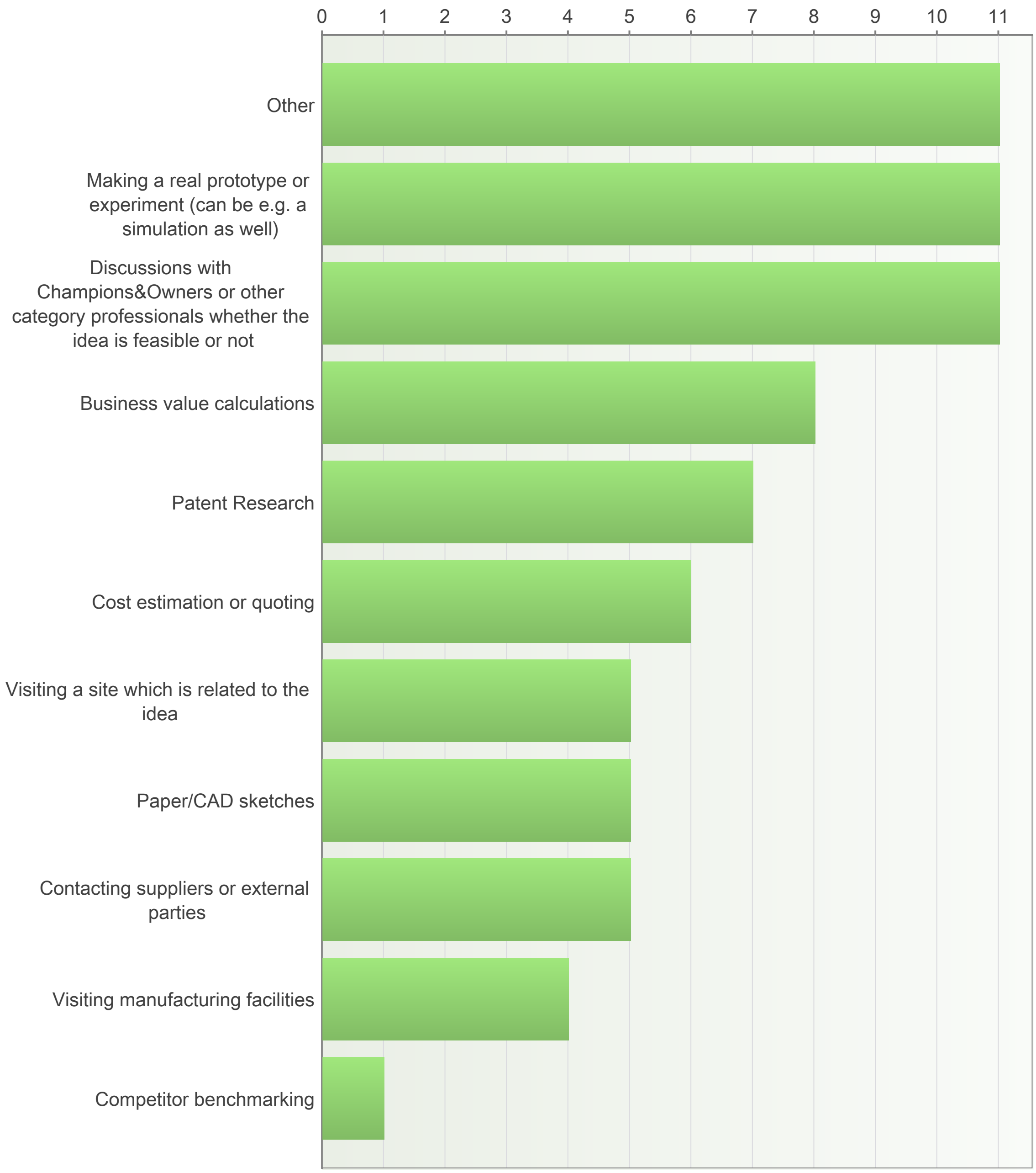
Number of respondents: 59



9. Yes - What kind of progress?

Select one or more options that match with your idea

Number of respondents: 29



Open text answers: Other

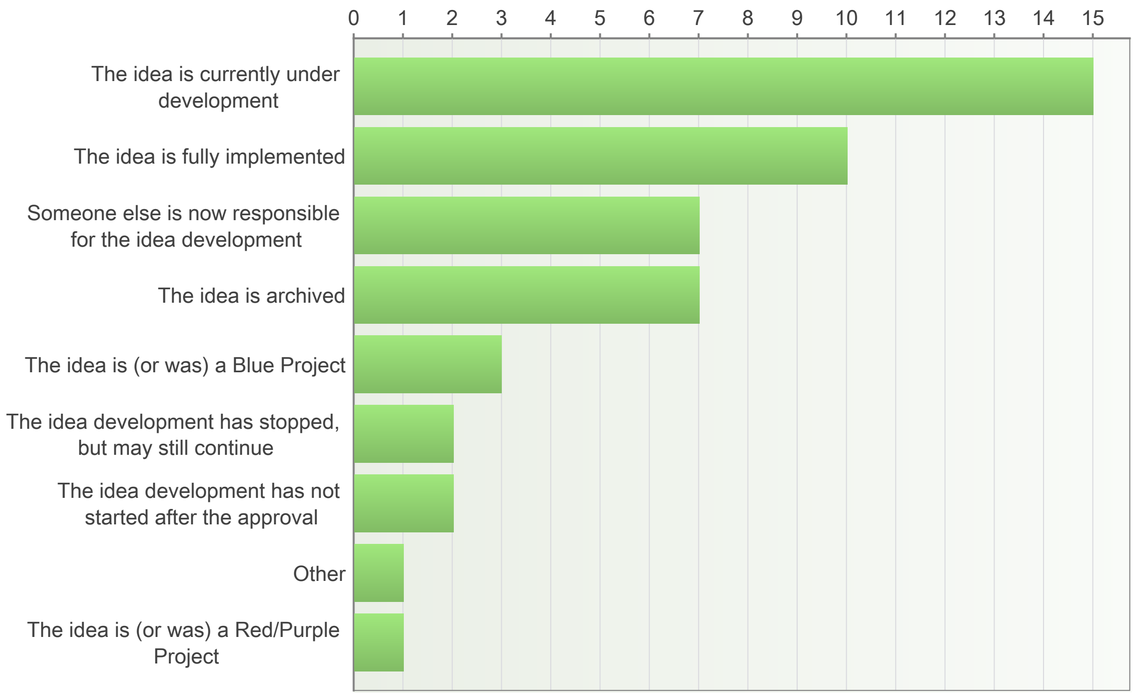
- Better prototype and blue project plan
- obligatory spell check to innovation tool
- evaluation of functionality
- Implemented to a car

- CR created and assign to Electrical category
- Software
- I do not know exactly, because I am not in charge of the idea development
- KRM Input : released to production in April 2016.
- It's a product now sold worldwide
- Put it in our backlog and made it
- Design updated accordingly

10. Backlog of the idea

Select one or more options that match with your idea

Number of respondents: 29



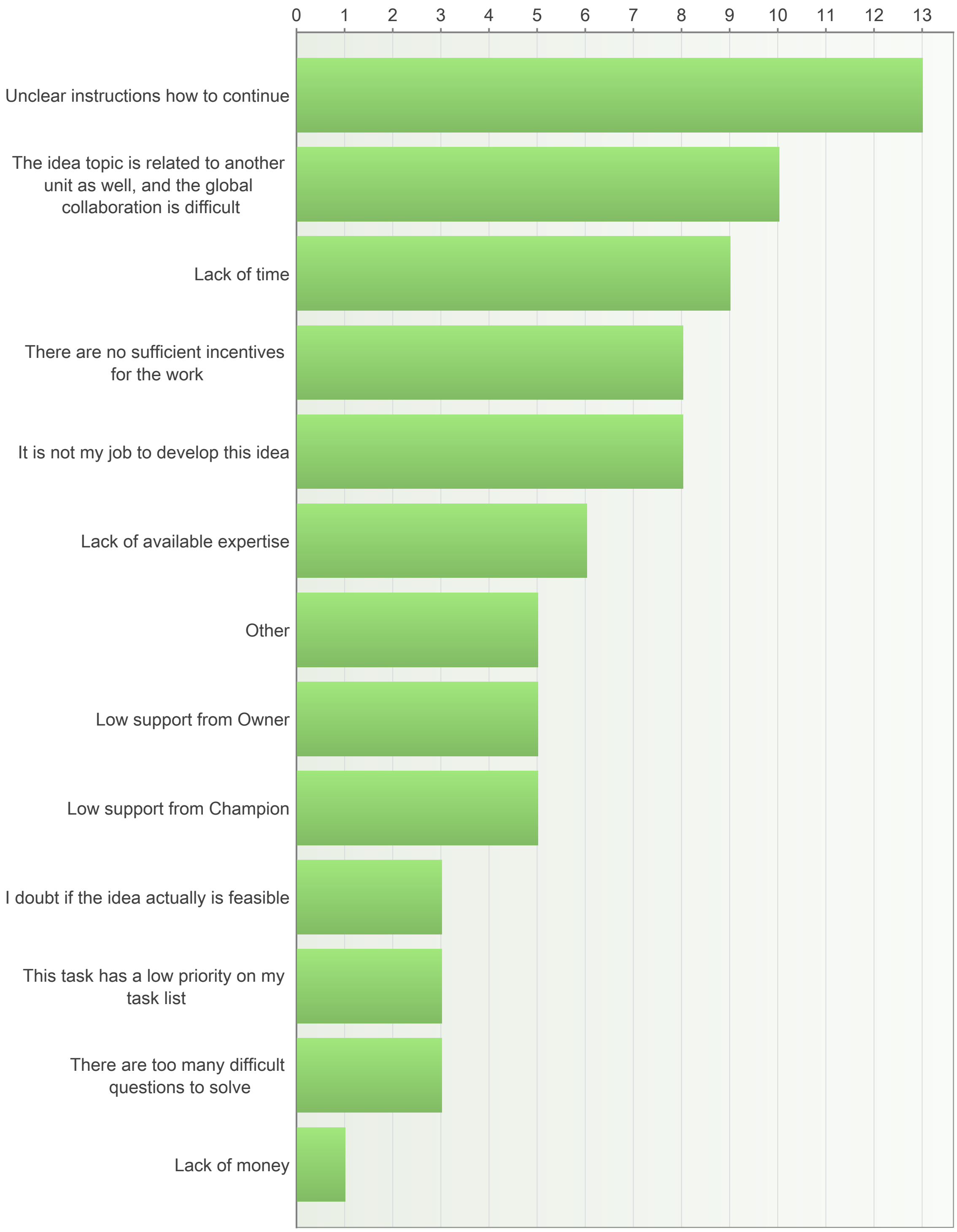
Open text answers: Other

- I do not know status

11. No - What reasons have stopped the idea development?

Select one or more options that match with your experience

Number of respondents: 30

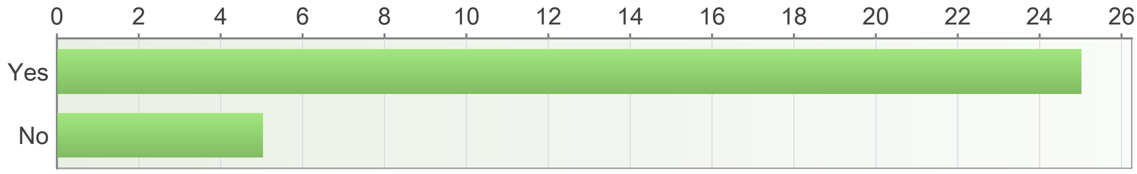


Open text answers: Other

- After approval there was no instruction and/or suggestion for the idea to move on.
- There seems to be no sufficient process in particular for escalators either to decide for the idea in general or to initiate a test set-up/mock-up
- Lack of Resources
- was informed that a project has been started and today learnt that it is completed
- Responsible in the factory does not response

12. I still feel that the idea is promising and would be worth to take forward

Number of respondents: 30

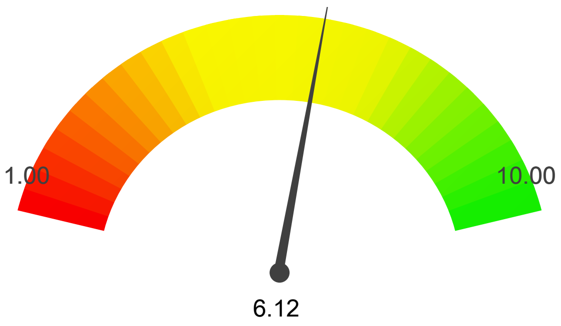


13. Innovation = Idea+Implementation

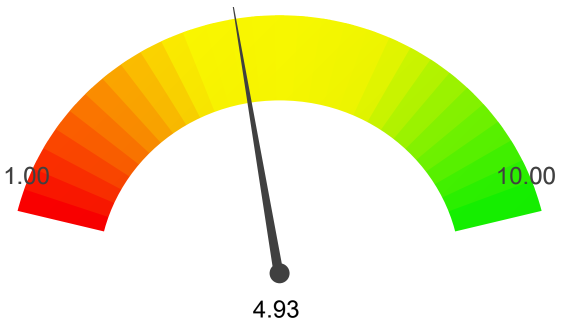
It is said that this is the most simple equation for innovation. Please tell how your unit is performing in the argument. 1: Not well 10: Very well

Number of respondents: 59

How well is your unit performing in the ideation part?



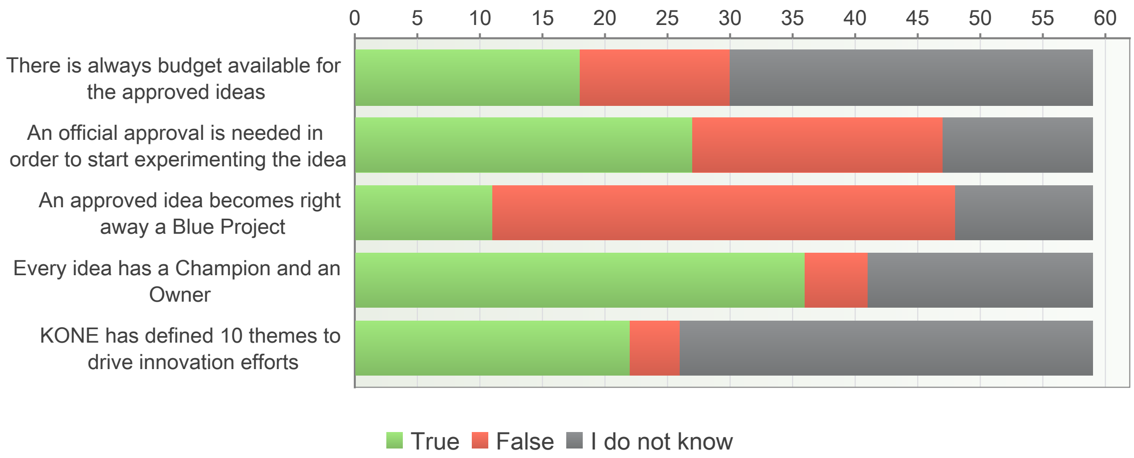
How well is your unit performing in the implementation part?



14. True or False?

Be honest and don't take this too seriously :)

Number of respondents: 59



KONE

15. Please give any ideas how the ideas-to-solutions success rate could be improved?

Number of respondents: 27

- Penalty for Owners that do not handle ideas in time
- Once an idea is placed into the innovation tool there is no visibility of what happens after submission. The process isn't clear and the involvement of the idea creator is minimal to non-existent. This is unfortunate, because my proximity to the innovation manager within my unit should improve this. The capacity of this role seems to be undercut but the true availability of budget (time/resources) to implement/test the ideas.
- More of these "quick and dirty" checks for ideas without large effort on planning to get the development going, and to see whether the idea is worth anything. Prototypes are also important for connecting different shareholders and share ideas. After initial checks planning is also necessary (cost-wise) and communication and documentation is important to know what is/was going on later on.
- Better definition on next steps to be followed after an idea is approved. After the idea is approved there's no specific process to keep further developing the idea.

  Sometimes it's difficult to further develop because the innovation ideas are not part of our everyday workload, sometimes, we develop those ideas after working hours. Giving us some of our work time to development will also improve the idea-to-solution rate.
- There should be a process for ideas that come out and are put in the Inno Tool and become approved. Locally there should be a person to proper follow up the process not as an "extra" task done in their "free" time, but something that should be part of their daily priorities to make it part of the unit culture and everyday topic. This way an engagement could be created within all colleagues.
- Sharing the success stories
  Rewards
- some kind of ranking would help in screening ideas in
- 1) There should be a nominated innovation leader in each R&D unit leading all the ideas-to-solutions. Leading means he / she should be following up all ideas' development + implementation progresses in his / her R&D unit.
  2) The nominated innovation leader should also call periodical steering meeting (e.g. monthly) to review all the ideas' progresses (e.g. status / criticalities / next actions / proposals / conclusions, etc.)
  3) R&D people should have specified time (5~10% of working time, e.g. half a day per week) & resources (incl. budget / workshops / both internal & external training + learning + brainstorming) just focusing on innovation topics rather than stuggling every minute in daily work (= release contents + feedback / quality issues).
- 1) May ideas are archived based on previous experience. World is changing we need to recheck the archived ideas as they may be feasible now.
  2) There should also be a mix of experienced and less experienced person in the innovation ideation approval team. This is needed to push champion from the box constrained by their previous experiences.
- Innovation owner should divert the approved ideas based on category to their KTI project team as blue or Categories as CR
- 1.idea should automatically mail to everyone when a person placed his idea in an innnovation tool.
  2.themes and contents in the innovation tool need to be change
- Problem is that Innotool is not part of anybodys daily work. It is only another annoying extra task. Decisions of further development are made alone. Answers to comments take ages. Of course really good ideas are taken into discussions at once. As a Champion I have no idea what happens after my comments. And I think idea maker does not know even as much. At least the ideas that are taken into use, should be informed to idea maker. I do not know if this happens now. AS Innotool is open forum and all the ideas are seen by all R&D personnel. Could we make InnoFace discussion forum that would be easy to access. No sign in and searching passwords (why they are needed in the first place, everybody in R&D has access rights anyway?). Champions

could raise ideas to this forum. People who are involved to the subject would be woken up to see what interesting is ongoing. At the moment ideas are pretty much seen only by champions and owners. Of course these info's would soon be classified as junk mail.

- Don't know how it's done currently, but are the ideas reviewed to find synergy and combination which could lead to more overall solution. there are many very detailed ideas focusing very limited components/scope in innovation tool...
- Wrong question. RIght question would be how to get 5 times more ideas & innovation disclosures out of R&D? Answer to this right question would be to first create this 5 times higher target than currently. Next progress towards this target should be followed at least quarterly and reported to whole R&D to be able to see how we perform.
  This should be done at cost center level to see which cost centers contribute and which claim to be too busy. Also actual ideating culture promotion should then be even better communicated by FRD leaders.

  Then answer to the original question. Partly same remedies help as to the question above. Promotion is needed, target and follow-up is needed. In this case there should be cost center specific follow-up of how people HELP to improve ideas in innovation tool. Currently it shows that some people being forced to act as champions/owners, are not trying to really help, instead you get the feeling that they are more trying to discourage ideas.

  If we are lucky enough to get these proposed processes working, then similar follow-up should be widened to follow also number of innovation disclosures per cost centers. Gamification approach might help here also so that it could be even considered to take all this idea creation+others' idea improvement+innovation disclosures counted on personal level and show it to all as a game.
- Innovation is the passion of improving KONE product/our own product
  We should be the leader and role model of implementing innovative solutions.
  For that innovation should not be a forceful one & not only for appreciation/award
  It should be a part of our regular job. Now our own priority job is there and the part innovation is always missing. In Product development matrix innovation column should be there – New product development team should brainstorm for this - may be an hour in a week….etc.
  Let’s challenge the world with innovative solution – Keep the ranking and Name in Top
- Local innovation manager should take responsibility to drive the ideas and, support to push champion and Owner to comments. After technology validation, we should track and develop those promised and approved ideas.
  Local concept team shoud work together with innovation manager.
- unit manager can approve the Idea generation and make prototype, end of the year it can be displayed in unit level and make use of the for other upcoming project
- - In general there are too many ideas in the innovation tool
  - Basically this is positive and shows the willingness for inventiveness
  - The other way round there are also many poor and repeated ideas
  - Too many ideas block those who have to check and vote on regular basis (another item influencing work intensification
  - To be honest: the idea and the functions of the innovation tool are great, in the end human factors define the success
  - Decisions pro/con an innovation should not exclusively decided by upper management steering who are often far away from the real practical work
  - The measures and rules filing a new innovation should be higher (to be on the point / especially documentation and explanations are often not sufficient)

- It should be defined better the owner of development that should work on it , according to the time agreed with management, and there could be a follow up of the most promising ideas with owners e.g. every 3 months. This could help to push people in going ahead and to monitor that ideas are not in the LIMBO after the approval phase.

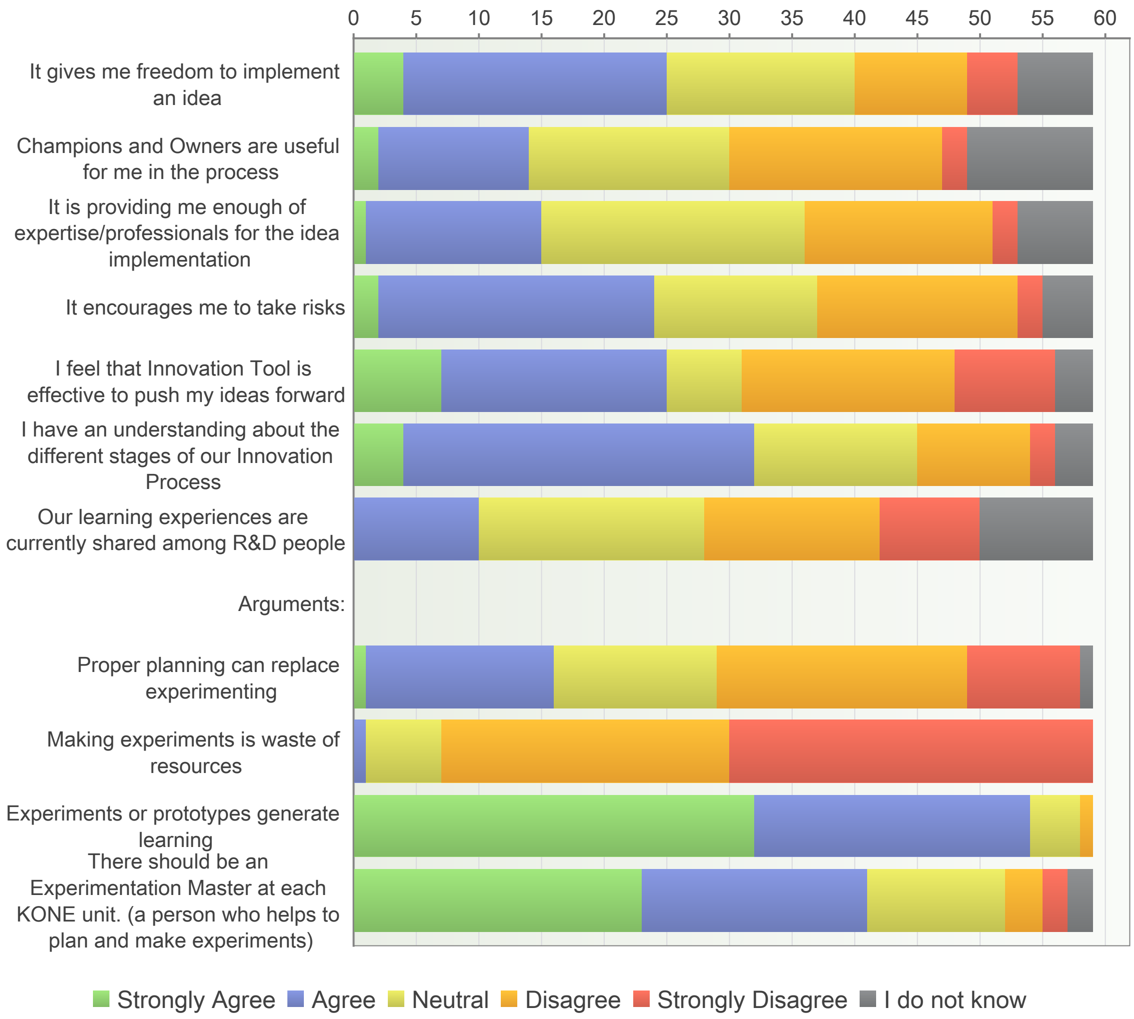
  In addition there are really some categories where champions and owners are really not processing ideas (like visual design or cars. Example ideas put more than 1 year ago and still in NEW state). Probably champions/owners have no enough time to dedicate to Innovation tool?! It could be useful to discuss with these people to understand problems (example lack of time could be solved giving temporarily extra people checking ideas and show to them just the most promising ones)

- Create a sort of Idea Factory, a facility where to test and experiment if idea works
- The idea must be presented to bigger group of people.
  I've asked patent for certain brackets and ten years later nobody has seen that
- Prototyping support as a sandbox environment, KONE engineers have dedicated paid hours to support the prototyping. More idea review meetings, especially cross-department ones.
- Why would you want to do that? You should cruelly kill off any and all ideas that you dont belive would be beneficial to KONE and not spend one second more on them. The success rate is in my opinion irrelevant, only the amout of solutions created matter.
- there should be proper follow up on the idea progress by the champion or owners. some of the ideas are stagnated for looooooong time. :)
- Response (Positive/Negative) push to the idea soon after the idea is posted.
- Understand the full chain impacts:
  Business case
  Investment
  Prototype
  Manufacturability
  Installation
  Maintenance
  Team cooperation
- more communication; encourage active experiementation

16. KONE Innovation Process

Please tell how you feel about our current Innovation Process

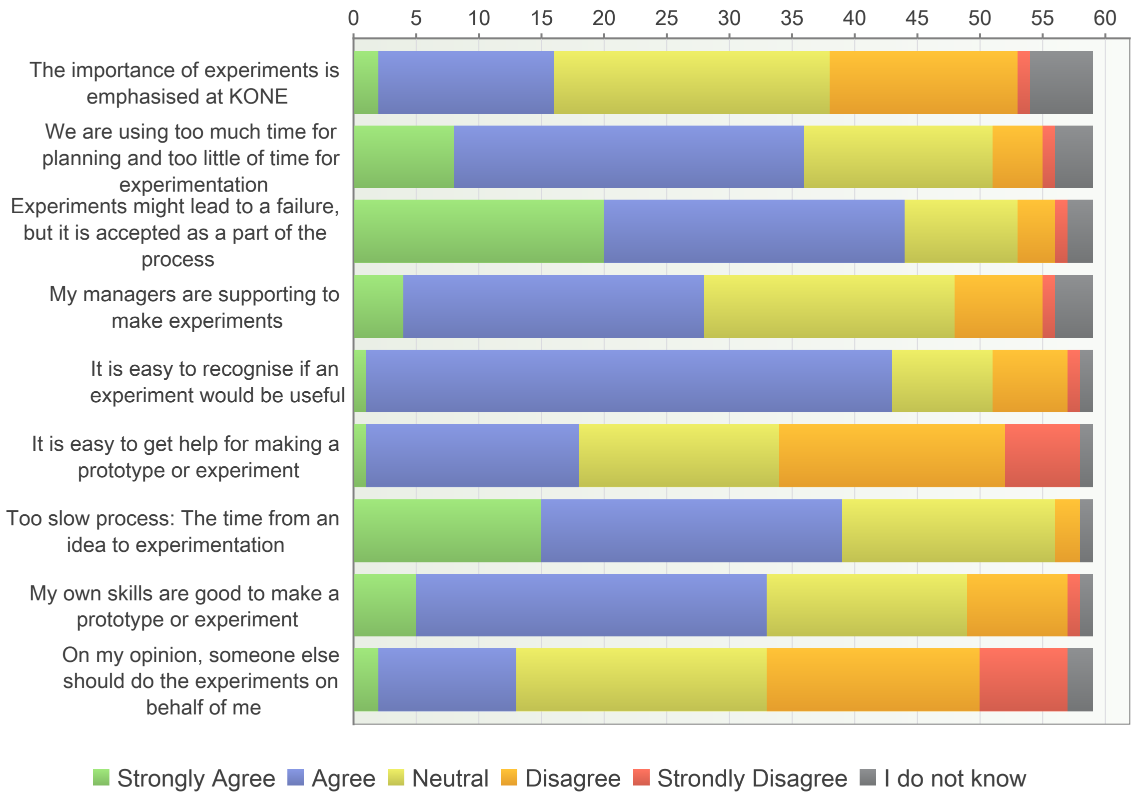
Number of respondents: 59



17. Bottlenecks of Experimentation

Here are some general arguments about the reasons that are potentially hindering Experimentation and thus innovations.

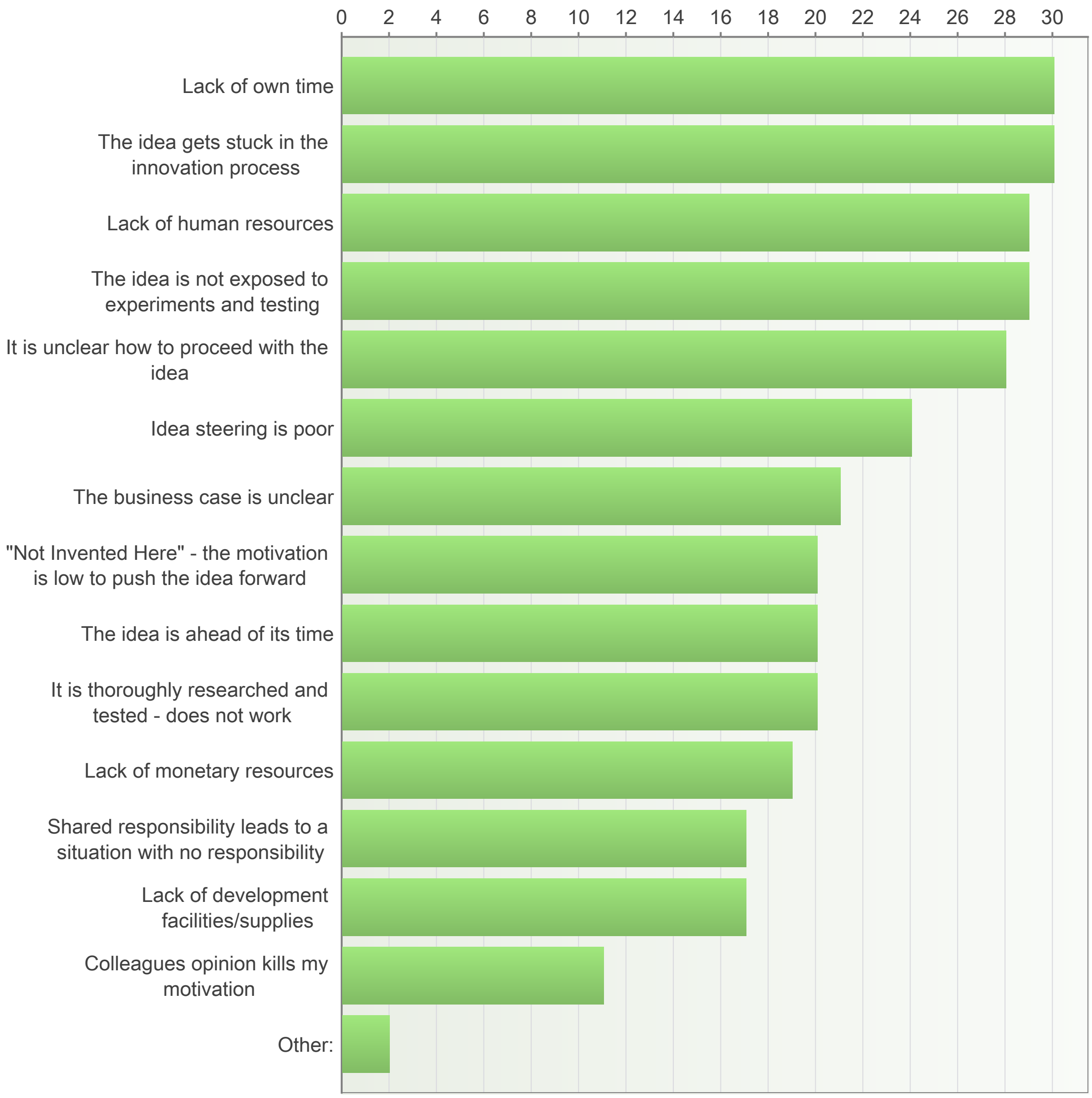
Number of respondents: 59



18. Why a promising idea or concept dies eventually?

Select one ore more options that match with your opinion

Number of respondents: 59

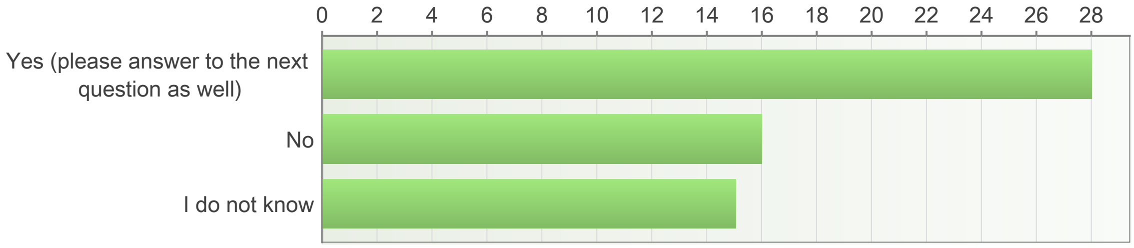


Open text answers: Other:

- Colleagues do not help to improve draft ideas
- Explanation of the initial concept is not sufficient and therefor misleading interpretation for decision

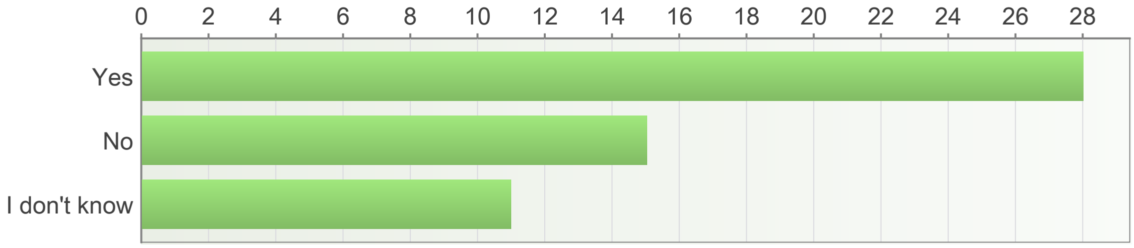
19. We have a place in our unit where we can make prototypes or experiments?

Number of respondents: 59



20. I have easy access to these facilities

Number of respondents: 54



21. Open feedback: survey, innovation processes, or anything!

Number of respondents: 20

-
- All of the opinions I have provided especially in regards to availability of places to experiment/test will be changing in the next couple of months due to the new facilities being set up in NA. From my start with KONE to where we are today I would say that the ability to innovate and move KONE forward has improved, but there is still a need to clarify and improve the innovation process.
- We should encourage testing more!
- We need more rapid prototyping, failing fast. When we build a prototype we actually build the complete solution and try to validate a lot of concepts in one shot; that increases the probability of failure in that big prototype. We can build a lot of rapid prototypes before, using cheap and easy to get materials, just to quickly test the main concepts of the idea. After that rapid prototyping process is done, is almost sure that the complete solution prototype will work.
- If there is an existing Innovation process, I would say it is not well communicated within all the units. It seems everything stays in HAT and that the rest need to make an extra effort to push their ideas. Also, right now, even if Innovation is a topic that is amusing for a lot of people, it doesnt seem like part of the daily way of doing things within all KTI levels. This is something that needs to be fixed because a lot of good ideas are dying even before they are posted in the Innovation Tool.
- Technology, market and innovation goes fast, very fast.

  Most processes are slowing us down to put new ideas to the market.
- Many Ideas are mostly commented positively, and then the owner doesn't take care to move further... it would make delay and ideas are easily diluted later. Presenters would feel not to worth of making any ideas.

  ALL IDEAS SHOULD EVALUATED WITHIN 3MONTHS
- Installation is missing from technologies. Installation is not only fixing bolts, it is a huge amount of methods, processes, tools and equipment. Please discuss with [name removed] about this.
- It would require time to make experiments. If you're involved in daily business activities then it' almost impossible to find time for experimenting other ideas than directly related to your current activities. More focus will be then developing your own daily activities than experimenting something new. Proposing new ideas is like pushing the ship from harbor without captain and you can't hear it anymore if you're not onboard by yourself. Ownership of the idea seems to be unclear. Anyhow when you have enough time to drive the idea then it seems progress.
- Approval/Archive process should be faster
- It is always good to look back our system to learn and make the system perfect - towards 100%. This survey may help to renovate our innovation process. We should always keep innovation as a part of development (Project, CR,..... Innovation brainstorming session should be mandatory) - It should be a part of our regular work. Every ideas to be recorded in the innovation tool must be visible to relevant people......etc
- Our place is not proper for electrical/electronic testing.
- - In my opinion this survey is really a good initiative

  - Innovation tool is a great opportunity to place new ideas

  - By making innovation tool more lean I see high potential to improve innovation tool to make it more successful and to improve satisfaction for the innovators

  - Thanks to the colleagues responsible for the innovation tool
- In my Unit people should understand better that Innovation is our work. Too many time I hear " I have no time for that".

  We could help them with easy and understandable process on how to proceed with ideas implementations. I think that trainings on how to use the tool are ok, but management support could be also in motivating people by example nominate a facilitator of the "idea developers team" to guide follow up.

- Idea Steering is missing from 2 years, Champion and Owner not active in Technology screening, too long time to evaluate ideas, sometimes no decision or follow-up on ideas submitted in Challenges.
- Somehow NIHIF syndrome is killing many good ideas
  (Not Invented Here In Finland)
  Many ideas, inventions are destroyed be people that take over or have to work with the product
- Thank god there is innovation tool! Slight reward system for prototypes that can work (demonstrated with elevator or with process) should be definitely looked into, so people would be encouraged to push forward their ideas for further evaluation by others.
- During approval/archiving ideas, requirement/need with respect to different region/countries must be considered, it is missing.
- it would be great help if there is a separate facility for experiments.
- Innovation seems quite far away from us. It should be part of our daily work.This is the main change this year.